PROCEEDINGS OF THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

1941

IMPERIAL MYCOLOGICAL INSTITUTE
13 JUN 1945

THIRTY-THIRD ANNUAL MEETING
JULY 8-11, 1941
AMES, IOWA

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Published by the Association
Edited by M. T. Munn
Geneva, N. Y.
Nov. 1941

Printed in U.S.A.
EDWARDS BROTHERS, INC.
Lithoprinters
ANN ARBOR, MICHIGAN
1942

THIRTY-THIRD ANNUAL MEETING

OFFICERS AND COMMITTEES

1940-1941

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F. A. McLaughlin, Amherst, Mass. . . Vice-President
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G. P. Steinbauer, " 3
----- " 4
C. M. Bass, " 5

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Range Grass Seed Studies	Elva L. Norris
Sand Tests	C. W. Leggatt
Viability Injured Weed Seeds	Dorcas Hooker

THE BUSINESS OF THE ASSOCIATION

REPORT OF THE EXECUTIVE BOARD

The meeting of the executive board was held at Ames, Iowa, July 7, 1941. Members present were, Messers McLaughlin, Stahl, Whitcomb, Porter, Munn, McIntyre, Pfaender, and Mr. Kinch, acting secretary. W. F. Cameron was representing I. A. Moore.

The following reports were presented, discussed and approved: News Letter Editor, Editorial Committee, Membership Committee, Rules Committee, Public Relations Committee, Handbook Committee, Program Committee, Research Committee and Nominating Committee.

Action was taken on the following points: It was moved and carried that Mr. McIntyre, editor of the News Letter, present his bill for financing the News Letter during the past year, and that the president and the chairman of the Editorial Committee work out ways of handling the News Letter in the future.

It was moved and carried that the president appoint another member to the Nominations Committee, and the Committee meet and bring in recommendations for the nominations of vice-president and secretary-treasurer to the Executive Board. Mr. Whitcomb was appointed to serve on the Committee.

MINUTES

The thirty-third annual meeting of the Association of Official Seed Analysts was held at the Iowa State College in Ames, Iowa on July 8-11, 1941. The following actions were taken at the meeting:

I. It was determined that the Proceedings, the History, and the Index to the News Letter should be planographed in separate bindings, and that the Index to the News Letter should be published on paper of the same size as that used for the News Letter.

II. The following actions were taken with respect to membership in the Association:

The seed laboratories of the State of Mississippi, the State of South Carolina, and the State of Wyoming were elected to membership in the Association.

Mrs. Ruby Ure Crouley was elected to honorary membership.

III. The following resolutions of the Committee on Rules and Regulations were adopted:

Resolution I. Whereas at the 1940 meeting the Association tentatively adopted the tolerances contained in the Rules and Regulations under the Federal Seed Act, be it resolved: That this Association adopt these tolerances and that they now be included in the Association's rules for seed testing.

Resolution II. Be it resolved that the existing rule for kind of seed under consideration and inert matter be amended in accordance with resolution IV presented at the 1940 meeting to read as follows:

"Kind of seed under consideration: This should include all seeds of the kind under consideration whether shriveled, cracked, or otherwise injured: Provided, (a) that in case of broken seeds and/or insect-damaged seeds, any piece larger than one-half should be included, while pieces that are one-half or less should be considered inert matter; and (b) that seeds of legumes and crucifers with the seed coats removed should be considered inert matter.

"Inert matter: Broken seeds and/or insect-damaged seeds when one-half or less; seeds of legumes or crucifers with the seed coats removed; undeveloped and badly injured weed seeds which upon visual examination, are clearly incapable of growth; dirt, stones, chaff, fungus bodies (such as ergot and other sclerotia and smut balls), and any other matter not seeds, should be considered inert matter: Provided, (a) that in the case of grasses, empty glumes should be considered inert matter and only glumes containing caryopses (grains) considered pure seed; (b) that attached sterile glumes of grasses should be considered inert matter and should be separated from the fertile glumes, but with some grasses (e.g., Rhodes grass), where the separation of the sterile glumes would involve an excessive amount of work, this procedure may be omitted, but the report should indicate such variation from the usual procedure; and (c) that the presence of fungus bodies, when present, should be recorded and reported."

Resolution III. Resolved that the incoming Committee on Rules and Regulations be instructed to revise the Association's rules so that they fit in as closely as possible with the Federal Seed Act Rules and Regulations.

IV. The Secretary was authorized to advise the Director of the Experiment Station and the Director of the Extension Service in every State that the Association of Official Seed Analysts recommends that each State study

the value of hard seeds more intensively and that material be supplied to seedsmen and to farmers relative to the value of hard seeds in crop production, and that the Secretary include with the communication a summary to be prepared by W. O. Whitcomb, of information that he has been able to obtain to date concerning the value of hard seeds.

V. The Association voted to present W. A. Davidson with a gift as a small appreciation for what he has done for the Association.

VI. Greetings and a bouquet of flowers were sent by the Association to G. A. Elliott, who has been ill following an operation.

VII. The Legislative Committee was instructed to determine how many states passed new seed laws and to what extent they follow the uniform bill.

VIII. It was voted that the Research Committee should this coming year make a very strenuous effort to organize Region No. 4, which is the southwest region.

IX. It was determined that the brome grass subcommittee of the Research Committee be discharged as having done a good job and that the Rules Committee study the recommendations of the subcommittee, namely, that 5 grams of brome grass be used in making purity tests instead of 10, particularly in the low quality samples.

X. It was determined that the research subcommittee on small seeds continue at least for another year to make a comparison of the fractional and Iowa methods for testing orchard grass and look forward to the possible adoption of one or the other, or both, as the accepted method of procedure by the Association.

XI. It was determined that the research subcommittee on weed seeds and the chairman of the Research Committee working together should prepare for the handbook a summary of the information we have to date on the viability of injured weed seeds and that the information be illustrated and published as a contribution to the handbook in sections showing who made the contributions.

XII. F. A. McLaughlin, vice-president, succeeded to the office of president and was duly inducted into that office. Since ballots circulated previous to the meeting had not resulted in the election of other officers the executive board took action to the effect that the president appoint another member to the nominations committee (W. O. Whitcomb was appointed to serve on the committee) and bring in recommendations for the nominations of vice-president and secretary-treasurer to the executive board. The results of the ballots returned showed that Chas. Stahl was elected vice-president and Elva Norris as secretary-treasurer.

XIII. President McLaughlin appointed the following standing committee chairmen:

Editorial, M. T. Munn, Experiment Station, Geneva, N. Y.
Legislation, R. C. Kinch, College of Agr., Lincoln, Neb.
Membership, Joseph E. Barnes, Bur. Plant Ind., Springfield, Ill.
Public Service, John E. Casey, Col. of Agr.,, Fayetteville, Ark.
Research, George P. Steinbauer, Expt. Station, Orono, Maine
Rules and Regulations, W. C. Pfaender, A. M. Ser., Beltsville, Md.

Report of Resolutions Committee

Be it resolved: That the Official Seed Analysts at their 33rd annual convention held at Ames, Iowa, July 8-11 inclusive, wish to express their sincere thanks and appreciation to:

R. H. Porter, Head of laboratory, Iowa State College and the seed laboratory staff for the excellent arrangements which have made it possible to enjoy a very successful meeting. Special arrangements for recreation and entertainment are deeply appreciated.

The Division of Agriculture, the Division of Science, Department of Botany, Department of Agronomy and Extension Service of Iowa State College, for their cooperation.

W. A. Davidson, our efficient Secretary-Treasurer who has so ably served the organization. It is hoped that his present duties will soon adjust themselves and that he may again be able to resume his association activities.

Respectfully submitted,

Elva L. Norris
Louisa A. Kanipe
Erle C. Vaughn

TREASURER'S REPORT

June 1, 1940 to June 2, 1941

Balance as of June 1, 1940		$1,136.80	
Receipts:			
Laboratory dues	$650.00		
Proceedings	66.75		
News Letter	40.00		
Miscellaneous	1.60		
Int. on savings accounts	12.80		
		771.15	$1,907.95
Disbursements:			
Proceedings	$413.00		
News Letter	11.37		
Postage & stationery	60.00		
Bonding of treasurer	5.00		
Miscellaneous	17.70		
		507.07	
Balance as of June 2, 1941		1,400.88	
			$1,907.95

As of June 2, 1941:

Checking account	$744.06
Riverdale bank	388.19
Prince Georges bank	268.63
	$1,400.88

W. A. Davidson
Secretary-Treasurer

Auditing Committee: Joseph E. Barnes
R. C. Kinch

Report of Auditing Committee

The auditing committee has examined the books and records of the treasurer of the Association of Official Seed Analysts and find that they are substantially correct in every detail.

The committee wishes to recommend that the record of annual dues be kept in such a manner that those laboratories in good standing may be quickly ascertained by the committee.

Respectfully submitted,

(Signed) R. C. Kinch
Joseph E. Barnes

REPORT OF EDITORIAL COMMITTEE

The members of the editorial committee have each given close attention to their several tasks as specified in the constitution.

The editor of the handbook has already reported to you with much useful material and now needs the assistance of those members who have technical information of handbook quality.

The historian of the association is reporting this year with a manuscript covering some four years of work. With this history before you the efforts of the historical committee will be more fully realized.

The editor of the News Letter has spoken through that medium and also in his formal report which follows, and to which your attention is urgently solicited. Whether or not the News Letter fulfils its function will depend upon the support of the members of the association.

In preparing the material for the Proceedings an effort has been made to carry out the desires of the association to the effect that there be briefer, concise and definite committee reports containing only material of permanent value. To this end the committee has attempted to call to the attention of authors places where reports lack substantiating evidence or where a paper or report can be very materially shortened because of long introductory discussions and summaries, together with repetitions, and the inclusion of much daily-work-sheet type of data. In several instances expert advice has been sought to guide the editorial committee in its final review and thus make our publications of a high grade. - M. T. Munn, Chairman.

REPORT OF EDITOR OF HANDBOOK

The Handbook has been increased by seven articles:

1. Germination of Freshly Harvested Cereals, N. G. Lewis.
2. Laboratory Determination of Seed Viability, R. H. Porter
3. The Use of Ultra-Violet Light in the Identification of Lolium perenne and Lolium multiflorum: A Compilation, W. H. Wright.
4. Millets (Panicum, Setaria and Pennisetum), W. H. Wright.
5. Physiological Problems Involved in Seed Dormancy, E. H. Toole.
6. Germination of Cottonseed, D. M. Simpson.
7. Seed Longevity and Storage, E. H. Toole.

A revised edition of the last contribution will be ready for distribution before very long.

The Handbook has been very well received so far and many copies have been sent out in answer to special requests. Unfortunately it is very difficult to get members of the Association to make contributions. If the work is to continue satisfactorily more effort will have to be made by the members, not only in the preparation of contributions, but in making suggestions as to what should be written up.

Apparently there is some interest in the Handbook outside the Association and the Commercial Seed Analysts Association, because some requests for copies have been received from agricultural libraries. Copies of the latest articles have been sent to all Association member laboratories and to the commercial analysts.

There are still a number of copies of last year's contributions available which will be sent out on request together with additional copies of this year's papers. - W. H. Wright, Editor Handbook.

REPORT OF THE EDITOR OF THE NEWS LETTER

Perhaps no function that I have performed in relation to the Association has given me greater satisfaction than that of editing the NEWS LETTER.

It may be that this responsibility should have fallen on the shoulders of some other person. I trust that I may be forgiven for having assumed this responsibility should anyone else have been desirous of being appointed editor.

I, for one, have never fully appreciated former editors, nor have I fully grasped the potentialities of such a publication until I, or rather, we--the laboratory force--went to work. Many helpful suggestions were received and my co-workers gave freely of their time. The News Letter was given a must place in our program. It should always occupy a prominent place in any program.

The News Letter can be made still more interesting, should the membership decide to freely support it through contributions large or small. It is not necessary that the articles be based on research. News items or reports of observations will make the issues interesting. Many times I have longed for a short note to fill out a page or to provide some humor to lighten up heavier articles.

I know of no better way for the members to express themselves than through the News Letter. In other words, this publication can be a series of small conventions - six to eight times a year - and material can be discussed and boiled down for the annual convention or be an overflow for items not printed in the annual Proceedings.

The News Letter is the mouthpiece of this organization and should be heard by the seed trade and those publications which serve the field. As it speaks, so will the echo return. (My memory seems to tell me that someone in every laboratory was charged with the responsibility of sending in material to the editor. Your shortcomings are, hereby, forgiven.)

By way of summation, there were seven issues of the News Letter and a Directory distributed this year. If, for any reason, any eligible laboratory did not receive their copies, this matter should be directed to the editor, who will cause the issues to be put in your hands.

In conclusion, I am offering the following suggestions for what they are worth: First, the early appointment of a permanent editor, one who has the time, the equipment and the desire to do the work. Second, that an up-to-date mailing list be made available annually to show who was entitled to receive the copies and the number of issues to be sent. Third, that the editor be advanced $50.00 to $100.00 per year for supplies, and that he render a report. Fourth, that a suitable cover be provided, the size, shape and color to be agreed upon by the executive board. Fifth, that the editor be paid a nominal sum for his time spent in getting out the News Letter, so that this responsibility will, in a manner, carry a remuneration that will counter-balance the work connected with the office. This will relieve the editor of the feeling that he is carrying more than his share of the responsibility of this Association. Perhaps the task will then be requested rather than forced upon any individual. Sixth, that a fair supply of News Letters be filed annually to replace lost issues, as a reserve for those delinquent in paying their dues, and for new subscribers.

May I add that we are indebted to the Seedburo Equipment Company for the new covers.

I wish to take this opportunity to thank all of you for your indulgence and cooperation and to ask your pardon for my shortcomings.

To the new editor, I will give full cooperation and wish him the best of luck. - C. N. McIntyre, Temporary Editor.

REPORT OF THE PUBLIC SERVICE COMMITTEE

A year ago the report of the public service committee included a recommendation that this Association sponsor a "National Seed Week" but for want of unanimous consent the Association recommended instead that this committee assume the role of sponsoring seed schools and seed exhibits at county and state fairs. This was to be an educational program and would accomplish the end sought in advocating national seed weeks, perhaps, and so your committee accordingly set up such a program. Report of the committee's activities follows:

First, reports from a few states were received, though your chairman appointed members in eight sections of the United States who were instructed to contact leaders in the states of their respective areas. The fact is, with one or two exceptions, the reports from committeemen include only their home states. These states, in the order of the reports in the subjoined outlined, are Oregon, Idaho, Colorado, South Dakota, Arkansas, Indiana, Kentucky, and North Carolina. It would appear incidentally that in order to have reports from each state we should have 48 members of the committee.

Oregon: This state has one of the most thorough and comprehensive programs on weed control anywhere in the United States. In many of the counties there are weed control programs revolving around county weed councils whose membership includes representatives of the usual farm groups and agencies and, in addition, such other agencies as the county court, custodian of state lands, Department of Interior, Indian Service, state highway, and railroad companies. The function of these county weed councils is to build up public opinion and to work with county courts in getting appropriations to support weed eradication programs. They also make recommendations regarding employment of local weed supervisors and the purchase of equipment such as tractors, cultivators, weed burners, and spraying machines. Weed districts are formed, provided by state law, in those areas where the people are "weed conscious" and from these the work is enlarged and expanded to include adjacent territory as the results of the clean-up campaigns become known. This service is supplemented by wide distribution of weed mounts and bulletins on weed control. Other activities include seed schools, exhibits at county and state fairs, and operation of new seed and weed laws. An important provision in the seed law is that which regulates farmer-to-farmer sales of seed and this, the report states, has been as much help in controlling the weed and seed problem as any other one thing. The report emphasizes the fact that there is the closest cooperation among seed councils, commercial and official seed analysts, resulting in wide-spread interest in weed control and the use of high quality planting seed.

Idaho: The agricultural extension service and the seed laboratory working together conduct weed and seed schools in various areas in which identification of the worst weeds and the use of the better grades of seed are emphasized. "These schools have been a valuable means of increasing the use of pure seed throughout the state," the report states, but there is still a large number of farmers who use little care in the selection of their seed stocks. The concluding paragraph reads, "In Idaho we spend hundreds of thousands of dollars on the control and eradication of noxious weeds and

unless we carry on extensive educational campaigns on the selection and use of pure seeds a large part of the good obtained from these expenditures would be lost."

Colorado: The legislature enacted a new weed law but failed to pass a proposed new seed law. A series of meetings were held during the year to educate people as to the weed problem and the function and purpose of the new weed law. In addition, the grain drill surveys, for which Anna M. Lute is given credit, have continued to be made and this information has been presented to Colorado farmers to show them that "A large percentage of Colorado farmers are guilty of planting seed of very inferior quality." Distribution of a weed bulletin, "Weeds of Colorado," has reached many farmers, emphasizing the function or role of crop seed in introducing and spreading weeds and stressing the importance of using high quality seed.

South Dakota: The course in Agronomy of the State College described as "Seed Inspection" includes such topics for study as weed identification, weed control, seed analysis, seed-borne diseases, and seed treatment. Other means of carrying on an educational program are named as exhibits on seed cleaning, seed-cleaning equipment, equipment for seed treatment, short courses in the College on weeds and seeds, and presentation to seed dealers' associations of material relating to methods of weed control and eradication, along with discussions on the importance of planting high quality seeds. In the State College research projects on seed-borne diseases, effects of seed treatments, rates of seeding and stands obtained of crop seeds of varying quality are studied with the view of making available to farmers results of such experiments. Under "Service" the report enumerates the following as part of the educational program: (1) the distribution of seed plates containing seeds of South Dakota weeds; (2) distribution of specimens of common and noxious weeds and of specimens of crop diseases to high schools; (3) assistance by the seed laboratory in revising the crop improvement association certification standards and in preparing a new seed bill and weed bill to be considered by the legislature.

Arkansas: A new course has been added to the curriculum of the College of Agriculture of the University of Arkansas, called Weed Identification. The purpose of this course is to teach college students how to identify weeds and to appreciate the importance of preventing and eradicating pernicious weeds. The course will also emphasize the importance of using high quality planting seed to insure maximum crop production of high quality. Many of these students will become county agents and vocational teachers and they will thus be in position better to advise farmers and teach rural boys concerning the damage caused by weeds and the financial advantage of using good seed. Tentative plans call for holding seed schools over the state, seed cleaning centers, and this fall to make use of seed exhibits at county and state fairs. Incident to the enforcement of the seed law, farmers are becoming more seed and weed conscious and last year hundreds of farmers were granted permits for sale of locally grown seed. The College of Agriculture, the agricultural extension service, the Arkansas Seed Growers' Association, the State Plant Board with its seed laboratory service, farm organizations, seed dealers, and seed distributors all have taken note of the importance of instituting measures to improve the quality of crop seeds and of the means at hand for controlling and eradicating noxious weeds.

Indiana: The educational program, participated in by the agricultural extension service, the seed trade, and enforcement officials of the state seed law, is organized so that district meetings are first held,

then county meetings in each district. These meetings promote the use of better seed, afford opportunity to discuss weeds in their relation to better seed, acquaint farmers and dealers with provisions of the state and Federal seed laws, and recommend crop varieties for various districts and areas of the state. Newspapers, magazines, posters, exhibits, demonstrations, contests, distribution of bulletins on good seed and weed control, all are used in promoting the program. County agent meetings, field meetings during the growing season, vocational high schools, seed schools in many of the counties, the state fair, and county fairs give opportunity for presenting the program. Worthy of special mention is the "movable exhibit" used for the county fairs. This consists of panel discussions of better seed together with mounted specimens of some of the outstanding weeds. The central theme is "to point out the loss from weeds and how the use of better seed will help to prevent the introduction and spread of noxious weeds."

Kentucky: The program is carried on by the three agencies of extension in agriculture, agricultural conservation, and enforcement officials of the state seed law. At farm meetings arranged by the extension and conservation forces, in vocational schools, at meetings of the F. F. A. and 4-H Club boys, among other topics the seed inspector discusses the operation of the seed law, stressing the following points: (1) What the Kentucky Seed Law Is and How It Operates; (2) the comparative value of high quality and low grade seeds; (3) the bad features of being "price conscious" rather than "quality conscious" when buying seed supplies; (4) how to interpret the information on analysis tags; and (5) how that of all the various ways and means by which weed seeds may be introduced and scattered, impure seed is, without question, the most important. The report emphasizes the fact that many acres of land on which crop production has been reduced is due largely to the use of low grade field seeds and the presence of noxious weeds.

North Carolina: This is another state that is doing outstanding work to educate the seed-consuming public on the importance of using good seed and of controlling the weed menace. The Crop Improvement Association with its Seed Exposition takes the lead in promoting the use of better seed. This year the program and premium list were published by the Greensboro Daily News as a Farm Edition and in this issue of the paper of 32 pages, devoted principally to crop improvement via better seed, appear no less than 32 articles, all emphasizing better seeds, seeds of new and better varieties, and better adapted varieties. The following gives an idea of the importance of this meeting: "Thousands of farmers and agricultural leaders from all parts of the state will be attracted here by the displays of certified seed, ranging from potatoes to corn, and all types of small grains to the leading legumes. Discussions of the seed improvement program will take place at three formal meetings of the Association." The State College Experiment Station, the state seed laboratory, the seed improvement division of the extension service, working with the Crop Improvement Association, foster the development of imporved seed of field crops adapted to North Carolina conditions and provides for the multiplication and certification of such seeds. Truly, North Carolina is making great strides in its program of seed education and sister states of the South could well follow the example of North Carolina's progressive agricultural leaders and farmers and develop programs for disseminating vital information relating to seed use and seed production.-

John E. Casey, Chairman.

REPORT OF RESEARCH COMMITTEE

The work of the research committee was as extensive in 1940-41 as in any previous year. In addition to the five regions in which refereed work was carried on, seven subcommittees undertook certain projects of regional or general interest. This report presents a summary of the work in each region followed by the several subcommittee reports.

The name, date of appointment and date of retirement for each regional chairman is as follows:

Region	Chairman	Date of appointment	Date of retirement
1	N. G. Lewis	1939	1944
2	R. H. Porter	1936	1941
3	G. P. Steinbauer	1940	1945
4	No one obtained.	Filled by R. H. Porter in 1940-41.	
5.	C. M. Bass	1938	1943

REPORT FOR REGION NO. 1 - NORTHWEST
By N. G. Lewis, Calgary, Alberta

There are 10 official laboratories in region No. 1 and of these, 8 participated in the referee work in 1940-41. Two commercial analysts also took part in the work.

In order to make it possible for the busier laboratories to take part without haste at the end of the season, referents were reduced to four in number. The samples represented problems peculiar to certain groups of laboratories, but are likely to be encountered, though less frequently, in other groups. All were of such a nature that a large amount of time was not required for their analysis and germination. The results are of interest insofar as they show agreement between different laboratories or as they point out where disagreement should be rechecked by further tests. Reports upon each referent are given below.

Referent No. 1 - Michel's Rye

This seed has been produced in Idaho and Washington and has been shipped into Saskatchewan, Alberta and other parts of region No. 1. The sample of Michel's rye was supplied by Jessie C. Ayres of Boise, Idaho. The principle difficulty encountered when dealing with this seed is its indistinguishability from common rye. Another difficulty in making a purity analysis is with the fairly high proportion of broken seeds. The embryo end is usually small and the endosperm end is large. Thus the former is placed in the inert matter fraction and the latter in the pure seed separation.

Results returned on the sample of Michel's rye as to its purity and germinability are given in Table 1.

It will be observed that the pure seed percentages are in reasonably close agreement. The half-seed criterion seems to have been applied.

The germination test results show no difference attributable to the substratum used. Germination of the sample was low and mold was a factor. Apart from variation assignable to the nature of the sample itself, there are some differences attributable to interpretation of weak sprouts. Variation in analysts' remarks indicates that this would be the case. The difference of opinion or interpretation might be settled by planting the seeds deeper in soil or sand. Results from prechilling are not given since this

practice was not generally effective. In some cases, reductions of mold as a result of prechilling was reported.

Objection to the placing of the small germ end in the inert matter fraction and the large endosperm end of a seed in the pure seed separation was not settled by this comparative work.

TABLE 1.- Analysis and Germination Results of Michel's Rye

Lab. No.	Pure Seed	Germination at 20° C.			
		Germination in Blotters		Germination in Sand	
		Normal	Inert Normal	Normal	Inert Normal
	%	%	%	%	%
1	97.2	69	17	69	18
2	96.2	65	21	60	20
3	94.9	63	19	58	8
4	97.1	59	2	66	1
5	95.9	75	25	74	24
6	97.0	69	14	73	-
7	95.8	76	20	79	30
8	96.5	73	18	71	22
9	96.7	65	22	70	19
10	95.9	71	0	72	28
Ave.	96.3	68.5	-	69.2	
Range	94.9-97.2	59-75		58-79	

Referent No. 2 - Nematode-infested Chewings fescue

Seed for this test was supplied by Louisa Ames Kanipe of the laboratory at Corvallis, Oregon, who also supplied the following information:

This sample is a composite sample selected and arranged in order to illustrate the more difficult types of separations found in various samples or Oregon-grown Chewings fescue seed. In the purity separation there are three aspects to be considered. First, in other crop seed both Lolium multiflorum and Festuca elatior are present. W. H. Wright's handbook section, "The 'Seeds' of Perennial Ryegrass and Meadow Fescue," should prove helpful in separating these seeds. Second, a few weeds which are considered typical in Oregon-grown seed, such as Madia sativa, Sanguisorba annua, Gilia capitata, Crepis capillaris, and Navaretia intertexta, have been added. Third, the inert matter consists of mostly sterile florets and nematode galls. In order to facilitate the study of these galls, two sets of bottles have been prepared, one containing normal florets and caryopses to be compared with the bottles containing nematode galls and galls enclosed in the lemma and palea. When studying doubtful seed it is well to remove the lemma and palea until a degree of accuracy is reached. The study of these should be made before the purity analysis is begun.

When viewed with transmitted light, either on a diaphanoscope or by holding the floret on edge over a white paper so that the light will pass through the lemma, the outline of the caryopsis or the gall is clearly discernible.

In order to procure the second-stage larvae, two or three of the dark galls can be placed in a few drops of water and allowed to stand three or four hours, the larvae will emerge and appear as fine threads in the water easily observed by holding the vial before a light. These can be

minutely examined on a slide with a low-power microscope. When in water the larvae tend to congregate in cottony balls.

Perhaps the best source of information on nematodes of this type is found in "Plant Parasitic Nematodes" by T. Goodey.

Each analyst was furnished a brief summary of the description from Goodey's text as an aid in making the determination.

Some of the differences may be outlined as follows:

	Normal caryopses	Nematode galls
Shape	oblong	lanceolate
Color	buff, occasionally dark brown	orange to purplish black
Markings	embryo line on the dorsal side marking the region of attachment of the ovary	no markings
	Normal floret	**Enclosed galls**
Shape	oblong	oblong lemma and palea fit loosely due to lanceolate gall

The results are given in Table 2. About half the analysts did not report duplicate pure seed results so it is difficult to assess the pure seed results. The 75.4% of laboratory No. 2 seems to be too low, however, one duplicate having been 79.45% pure seed, the other 71.35%. The percentages of purity and of normal sprouts in blotters are too variable for a homogeneous lot but lack of experience with such material is probably the major cause of the variation. It will be noted that the sand test results varied less than did the blotter or other methods. There is, in general, an inverse correlation between pure seed and germination, and between pure seed and number of sprouts in the inert fraction. Many analysts gained additional experience in the study of nematode damage and took the opportunity of studying the nematodes themselves in water, as suggested. The sample was an interesting one.

TABLE 2.- Purity and Germination of Nematode-Infested Chewings Fescue Seed

	Purity		Germination in			
			Blotters or towels		Sand	
Lab. No.	Pure seed	Inert matter	Normal	No. in inert	Normal	No. in inert
	%	%	%			
1	77.6	22.4	89	38	77	35
2	75.4	19.6	85	-	81	100
3	79.1	20.9	82	47	79	5
4	80.4	15.6	78	6	81	3
6	79.9	15.7	77	11	80	2
7	83.9	12.1	76	2	78	1
8	84.2	11.8	76	0	74	0
9	77.9	17.6	85	5	81	-
10	80.5	15.6	75	3	80	5
Mean	79.9	16.8			79	
Range	75.4-84.2		75-89		74-81	

Referent No. 3 - Insect-Damaged Vetch

This was a sample of common vetch supplied by D. Forsythe of the laboratory at Pullman, Washington. It was damaged by weevils in such a manner that the half-seed criterion was quite difficult to apply.

The sample was actually damaged to the extent of 18% by insects, but by using the half-seed criterion only about 1% was placed in the inert material fraction. In view of the peculiar type of damage, pure seed determinations gave remarkable agreement between the laboratories.

Germination results (blotters) are shown in Table 3 and are somewhat more variable than the purity percentages, but when the hard seeds are added to the normal germination, the results agree closer, i.e., 84, 83, 83, 84, 85, 93, 91, 92, 87, 84. It would appear that differences in these figures depended upon the production or interpretation of normal sprouts for, if the dead seeds are subtracted from 100, the percentage viability of the sample is 96, 95, 95, 94, 93, 96, 93, 94, 92, 92. These figures are in very close agreement and indicate at least that sampling was uniform. Examination in this manner of the tests in sand cannot be made.

TABLE 3. - Purity and Germination of Insect-Injured Vetch Seed

			Germination in				
			Blotters		Sand		
Lab. No.	Pure seed	Normal	Hard seed	No. in inert	Normal	Hard seed	No. in inert
	%	%	%		%	%	
1	99.5	81	3	2	75	1	4
2	99.6	74	9	1	73		5
3	98.6	75	12	8	75	3	5
4	99.7	81	6	0	80	1	0
5	99.2	76	9	9	76	1	7
6	99.7	88	5	0	84	3	3
7	98.9	88	3	5	90	4	7
8	99.9	87	5	2	91		0
9	99.4	86	2	3	74		5
10	99.0	68	16	6	70		6
Mean	99.35	80.4			78.8		
Range	98.6-99.9	68-88			70-90		

Referent No. 4 - Bluegrass

Sample No. 4 was supplied by C. W. Leggatt at the chairman's request. Dr. Leggatt had assumed that it would be done by blower only, but one-gram samples were done according to the official method.

Results are wider than one would expect from random sampling and the trials should be repeated with a closer check on the method employed at each laboratory

TABLE 4.- Purity Analyses of Bluegrass - Official Method - 1-Gram Sample

Lab. No.	Pure seed	Inert matter
	%	%
1	88.23	11.77
2	87.50	12.50
3	88.21	11.79
4	86.69	12.81
5	86.52	13.26
6	90.10	9.51
7	90.71	9.27
8	87.51	11.80
9	85.95	13.66
10	87.00	12.60
Average	87.84	11.90

REPORT OF REFEREE WORK IN REGION NO. 2 - NORTH CENTRAL

By R. H. Porter, Ames, Iowa

Referee work in region No. 2 was confined to a study of the germination of two samples each of alfalfa and sweet clover seed. Tests were made in blotters and towels using distilled and tap water and in sand. The purpose was to determine if the tap water in any laboratory caused any injury to germination and to find out if a difference in blotters could be responsible for wide differences.

The procedure employed was to remove all but pure seed from a given quantity of the seed in question, then subdivide into 24 subsamples. Each cooperating laboratory was requested to use only the samples as received for a germination test. The data obtained are summarized in Table 1. In general there was not much difference in the mean percentages obtained from blotters and towels as substrata, although in a few individual cases, the towels gave significantly lower percentages than blotters.

The results with alfalfa sample No. 1 are most encouraging in that a fairly high degree of uniformity is evident. The results with sand are particularly encouraging. The mean emergence is only slightly more than the mean in blotters and the normal in sand is only 3% less than the normal in blotters. The data for alfalfa sample No. 2 are less uniform than for No. 1 and indicate a considerable difference of opinion. It is worthy of note that 6 out of the 13 laboratories agreed well in determining normal seedlings in sand in that the range was 64 to 70%. The other 7 laboratories obtained results ranging from 54 to 61%. The difference between the means of the two groups is highly significant. The difference in extremes of 16% both in sand and in blotters for all the laboratories is too great for homogeneous samples.

The results with sweet clover, sample No. 1, are about as variable as for alfalfa No. 2. We can expect more disagreement with sweet clover samples than with alfalfa, but repeated trials should eliminate some of the extreme differences. For sample No. 1, in sand 7 out of the 13 laboratories obtained percentages of normal seedlings ranging from 71 to 80%, or an average of 74.5, while the other 4 obtained percentages ranging from 65 to 69 with an average of 64.5. The difference between the two averages is highly significant. In blotters, 12 of the 16 laboratories obtained results ranging from 74 to 81%. Of the remaining 4, one obtained 84 and the other 3,

69 to 71%. The difference between the high and low groups is highly significant.

For sweet clover sample No. 2 the data show that 7 of the 13 laboratories obtained percentages of normal seedlings in sand ranging from 60 to 67 (average 64) and the remaining 6 obtained percentages ranging from 42 to 58 (average 49.3). This difference in the two groups is highly significant. Much the same results occurred in the blotter tests.

TABLE 1. - Summarized Results of Germination Tests of Alfalfa and Sweet Clover Seed Tested in Blotters, Towels and Sand and Using Both Tap Water and Distilled Water

	Normal seedlings and hard seeds observed									
	Blotters				Towels		Sand			
	Tap water		Dist. water		Tap water		Dist. water		Emerged	Normal
	N* %	Hard** %	N. %	Hard %	N. %	Hard %	N. %	Hard %	%	%
Alfalfa										
Sample 1										
Mean	74.8	12.9	73.7	12.7	74	12.9	72.5	13.3	76.3	71.8
Difference in extremes	10	6	7	7	11	6	14	5	9	8
Sample 2										
Mean	66.3	17.5	64.5	18.5	61.9	19.3	62.5	18.5	66.2	61.5
Difference in extremes	16	5	10	6	14	7	9	9	13	16
Sweet Clover										
Sample 1										
mean	76	5.4	74.5	5.0	75.5	5.0	72.7	5.4	77.8	72.1
Difference in extremes	15	4	17	4	17	3	20	6	18	15
Sample 2										
mean	58.4	2.2	57.9	2.3	57.1	2.6	55.7	2.3	62	57.2
Difference in extremes	25	3	21	4	30	3	26	2	19	25

* N = normal seedlings

**Hard = hard seeds

It appears that the technique employed with sand tests is somewhat better than last year, but that differences in emergence are far too great. More experience with sand tests seems desirable. Furthermore, emergence in sand should receive additional study as a measure of normal seedlings.

The tests with towels and distilled water were closely comparable and indicated that the tap water in use is satisfactory. The towels gave less uniform results than blotters, and because towels are less easily manipulated their use is undesirable.

As far as the results in the refereeing laboratory are concerned, they suggest that the interpretation of normal sprouts in blotters is 5 to 10% higher than in sand.

The data from the tests this year are similar to those in 1939-40 in that the laboratories are rather clearly divided into two groups, yet the percentage of laboratories in the group with the highest mean percentage

of normal sprouts is higher than last year. Over half the participating laboratories fall in the group with a more liberal interpretation of normal sprouts. It seems advisable to repeatedly remind ourselves that the emphasis placed on the evaluation of the so-called class of abnormal seedlings is disproportionate to its importance.

REPORT ON REFEREE WORK IN REGION NO. 3 - NORTHEAST

By G. P. Steinbauer, Orono, Maine

Three referee tests were carried out in region No. 3. Two of these dealt with problems in germination of crimson clover and timothy using blotters for the substrate and the remaining test was undertaken in cooperation with the subcommittee on sand tests under the direction of C. W. Leggatt. Most of the laboratories in this region took part in the tests even though some of the tests were sent out during the busy spring season. The following report deals only with the results of tests No. 1 and No. 3 since No. 2 was carried out under the direction of the chairman of the subcommittee on sand tests and will be reported separately.

Referent No. 1 - Purity and germination of crimson clover

Portions of a lot of crimson clover were submitted to the different laboratories for a purity analysis involving separation into pure seed, inert matter, crop seed and weed seed, and germination tests with blotters using tap water and distilled water. In the latter tests the results were tabulated to show the normal and abnormal seedlings and hard seeds. Thirteen laboratories participated in the tests. Of these, five were Canadian, one was federal, six were state and one was commercial. The summary of the results is given in Table 1.

TABLE 1. - Germination and Purity of Crimson Clover - Sample No. 1

	Tap Water			Distilled Water			Purity Composition			
Lab. No.	Normal %	Abnormal %	Hard %	Normal %	Abnormal %	Hard %	Pure %	Inert %	Crop %	Weeds %
1	78	11	4	77	13	4	99.00	.30	.05	.65
2	75	13	3	78	12	3	98.90	.30	.08	.72
3	79	12	7	79	10	10	98.80	.19	.10	.90
4	76	12	5	75	13	5	98.94	.35	.12	.59
5	80	11	1	83	11	1	99.01	.30	.00	.69
6	77	12	3	80	9	3	99.61	.00	.06	.33
7	76	14	3	80	13	1	99.10	.10	.10	.70
8	77	10	2	78	11	3	99.40	.14	.00	.46
9	78	10	3	76	12	3	98.90	.50	.15	.45
10	79	9	4	83	8	3	98.85	.45	.08	.62
11	86	10	3	82	11	3	99.96	.01	.00	.02
12	83	10	3	81	11	4	99.31	.17	.03	.49
13	75	16	2	72	17	2	98.65	.41	.12	.82
Totals	1019	150	43	1024	151	45	1288.43	3.22	.89	7.44
Mean	78	12	3	79	12	3	99.11	.25	.07	.57
Range	75-86	9-16	1-7	72-83	8-17	1-10	98.65-99.96	.00-.50	.00-.15	.02-.90

The results indicate that at least for the kind of seed used and for the laboratories involved there is practically no difference in results when using tap water or distilled water. In the majority of cases there was good agreement between the germination tests of individual laboratories and the mean of all tests. Laboratory No. 11 which reported the highest percentage of normal sprouts and also the highest percentage of purity stated that it had had but little experience with this particular kind of seed. It will be noted that laboratory No. 13 which reported the lowest percentage of normal sprouts reported a somewhat higher percentage of abnormal sprouts. A somewhat greater variation in hard seed content occurred than might have been expected. It is interesting to note that the results obtained by the use of distilled water and tap water were in good agreement within individual laboratories even though the range of 1-7 and 1-10 between laboratories seems somewhat large. A germination tests using sand as a substrate was carried out with this lot of seed by the Iowa Laboratory. The result of this test was 77% strong sprouts which is close to the mean of all tests using blotting paper.

Referent No. 2 - Germination of timothy

During recent years an increasing number of timothy samples of low vitality have been received for test by the different laboratories. This may be due to new methods of harvesting the crop, unfavorable methods of storage or other unknown factors. In this connection it will be seen that in the report of referee tests for region No. 5, 1940, there appeared results of tests of a timothy sample with a wide divergence of results between laboratories. The evaluation of germination tests on these low-vitality samples involves a number of different factors. There is of course the question of distinguishing between normal and abnormal sprouts, the optimum conditions for conducting such a test and also the length of duration of the test. In the latter connection it might be mentioned that the Rules for Seed Testing suggest 8 days for the duration of the test with timothy, whereas the directions for germination tests for the administration of the Federal Seed Act suggest 10 days and this period is also apparently used by the Canadian laboratories. It is of course difficult to make hard and fast rules to fit all cases but as the data presented below seem to indicate some improvement might be made for this particular kind of seed.

The sample of seed used for the test was obtained from a commercial lot sent in to the Maine laboratory for test. In reading the germination tests it was noted that many of the sprouts failed to develop normal root systems and therefore seemed to be suitable material for a referee exercise or trial. Portions of this sample were sent to the various laboratories for test, specifying blotters as a substrate and the reading of the tests to be made at 5 and 8 days. Replies were received from 11 laboratories. A summary of the results is to be found in Table 2.

It will be noted that there was a general tendency for the number of normal sprouts to vary inversely with the number of abnormal sprouts, suggesting difficulty in separating these two categories. While the coefficient of correlation was not calculated it is interesting to note that the laboratory having the lowest number of normal sprouts (44) had the highest number of abnormal sprouts (31) and that the average number of abnormal sprouts for the five laboratories within the range of 50-59 normal sprouts dropped to 25, and the five remaining laboratories reporting normal sprouts within the range of 60-67 had an average abnormal count of 21.

Several interesting comments were sent in by the various laboratories. A number of laboratories felt that for timothy a longer test period

such as 10 days instead of 8 days made evaluation of normal and abnormal sprouts easier. One laboratory stated that while a 10-day test was preferred the preliminary 5-day count would in their opinion give a more likely picture of the field performance of such a lot of seed. However, the Sackville, N. B., laboratory continued the test for a total of 20 days and found that many of the seeds produced secondary roots after about 10 days and that many of these seedlings would likely develop into normal plants under field conditions. This latter test yielded 77% strong sprouts within the 20-day period.

TABLE 2. - Germination Test on Blotters - Timothy

Laboratory No.	Normal Seedlings %	Abnormal Sprouts %
1	54	28
2	44	31
3	67	20
4	60	25
5	52	22
6	61	16
7	56	27
8	51	23
9 (Maine)	67	25
10	61	17
11	59	25
Totals	632	259
Mean	57	24
Range	44-67	16-31

The possibility of using sand as a substrate for this sample was considered by C. W. Leggatt who used the combinations of 15-25°C top of sand, 15-25°C in sand, and 6-day prechilling at 9°C followed by 20-30°C alternation on top of sand. It was felt that of these various trials the 15-25°C on sand offered possibilities for improved root development.

The application of a Vitamin B_1 solution was used by one of the commercial laboratories. The results did not indicate a beneficial effect.

The variation between results reported between laboratories does not seem to be associated with the type of blotters used. Using blotters submitted by nine different laboratories the range of results obtained when this sample was tested at the Maine laboratory was 54-59% normal sprouts.

Obviously this type of sample is worthy of further study. The majority of comments and remarks seemed to indicate a preference for a somewhat longer test period for final counts in timothy tests.

REPORT FOR REGION NO. 4 - SOUTHWEST

By R. H. Porter, Ames, Iowa

An unsuccessful attempt was made by the chairman of the research committee to have someone in region No. 4 serve as chairman for this region. Accordingly three samples of sweet clover seed were sent by the general chairman to the laboratories in this region. Reports of germination tests were submitted by two laboratories and the data are given in Table 1 which includes the results in the Iowa (refereeing laboratory). The data show

fairly close agreement in the blotter test results but they also indicate that one laboratory was apparently inexperienced in the use of sand.

TABLE 1.- Referee Test of Sweet Clover

Lab. No.	Pure seed %	Normal (N) and abnormal (A) seedlings, dead seeds (D) and hard seeds (H) observed							
		Blotters				Sand		Soil	
		N. %	A. %	D. %	H. %	Total %	N. %	Total %	N. %
Sample No. 1									
1	99.4	67.3	12.3	8	12.5	75	68	--	--
2	90.7	70.8	13.5	3.5	12.2	78	72.5	72	68
Iowa	98.3	68	11	6	14	81	34	79	37
Sample No. 2									
1	99.1	36	22.8	40.7	.5	43.2	31	--	--
Iowa	99.3	39.2	23.2	37.0	.5	47.2	36.5	39.5	34.5
Sample No. 3									
1	98.5	36.5	13.2	46.2	3.8	43.5	35.5	--	--
Iowa	98.9	48.7	11.3	34.3	4.5	45.2	42.2	41.5	39

The results of these germination tests in blotters are quite uniform for samples Nos. 1 and 2, but for No. 3 the differences are excessive. In sand the emergence is reasonably uniform for all samples but the interpretation of normal seedlings is too variable.

REPORT FOR REGION NO. 5 - SOUTHEAST

By C. M. Bass, Richmond, Va.

Owing to shortage of help and greatly increased routine work during the past twelve months collaborative work in region No. 5 was necessarily limited. One of our principal analysts having gone forward in the service of his country, made it necessary for the regional chairman to give only a small part of his time to associational work.

One new official laboratory and one commercial laboratory was added to our list. Otherwise our mailing list of collaborators was the same as last year.

Our project for the year was to study the behavior of seedlings in low-grade lots of timothy seed. There has always been wider variations, perhaps, in germination results on low-germinating lots of timothy than in most other kinds. Whenever there are a large number of weak or abnormal seedlings which are often observed in germinating timothy, various different analysts are likely to give them different interpretations of value. This is not a new problem; though we did attempt to throw some new light on the subject.

Only two samples were sent out during the year. Both were timothy seed of known low germinating value. Each produced a high percentage of weak seedlings showing varying types of development. This was noticeable in both roots and plumules.

The usual wide variations in results occurred between initial and duplicate tests within the same laboratory as shown by the results reported by the several collaborators. For sample No. 1 the highest germination test reported by an official laboratory is 83%, the lowest 25%. Commercial laboratories reported a high of 74% and a low of 36%. Fewer laboratories

reported upon sample No. 2 and the results as a whole are more uniform as is shown by the accompanying table. With but one exception the agreement in results in sand tests is very good.

It is very doubtful whether we can arrive at uniform results in interpreting test results of this character unless agreements can be reached in the germination room while actual tests are in progress. Possibly if those whose readings are low were more liberal and those whose readings were high were less lenient, a common standard could be agreed upon. It would then be quite essential to correlate this standard with the actual worth or field value of seed stocks of such degrees of viability and vitality.

TABLE 1. - Summarized Results of Germination Test Observations on Two Samples of Timothy Seed Which Showed Uncertain Vitality

	Normal germination and weak sprouts observed											
	Blotter tests				Soil tests				Sand tests			
	Normal germ.		Weak sprouts		Normal germ.		Weak sprouts		Normal germ.		Weak sprouts	
	A %	B %	A %	B %	A %	B %	A %	B %	A %	B %	A %	B %
Sample No. 1, 24 laboratories reporting												
High	87	72	59	28	70	60	24	17	78	66	26	15
Low	25	49	2	11	34	51	2	13	41	41	3	5
Mean	62	62	18	17	35	55	13	15	60	56	12	9
Sample No. 2, 15 laboratories reporting												
High	71	-	41	-	57	-	12	-	61	-	29	-
Low	36	-	15	-	39	-	2	-	43	-	2	-
Mean	47	-	25	-	48	-	7	-	62	-	15	-

On report forms submitted with sample No. 1, requests were made for sketches or drawings of different types of weak or abnormal seedlings noted. This request was made with the idea that it may serve as a stepping stone in the use of drawings or photography in interpreting germination tests and with the hope that more uniform results may be obtained. Some very interesting drawings were submitted. One attempt was made to photograph seedlings. This investigation, as brief as it was, might serve as an incentive to those who are artistically inclined to continue with their illustrative work. As a collaborative project, we hope to consider it further.

REPORT OF SUBCOMMITTEE ON BROME-GRASS SEED ANALYSIS

The work of the brome-grass subcommittee which has been carried on for three years was initiated because of the long time consumed in determining the purity of light-weight chaffy Bromus with ten grams as a working sample. The committee has sought to determine whether a quantity less than ten grams would give sufficiently dependable results to warrant a change in the amount to be used for purity analysis.

Four laboratories have cooperated in the work: Minnesota, Winnipeg, Iowa, and North Dakota.

Although emphasis has been placed on light-weight samples, other grades have been chosen also for the purpose of comparison.

Analyses have been based on samples of ten grams, each sample being

subdivided so that results on five-gram duplicates might be compared with each other as well as with the mean of results. The mean percentage purity of duplicates represents what would have been the result had ten-gram samples been tested as a unit.

In some cases considerable differences were noted in duplicate tests as well as between tests from different laboratories, but these were usually confined to low-quality samples. In general the differences were not significant based on the Chi square test for homogeneity. This test permits of smaller differences than the tolerance formulae in the Rules of the Association and the Federal Seed Act.

As reported previously, the committee is of the opinion that a five-gram sample is adequate to give sufficiently dependable results provided mixing is done thoroughly. Although it is true that in samples having a purity less than 70% greater differences appeared than in samples of higher quality, the committee believes that the use of a quantity smaller than ten grams is satisfactory for practical purposes, especially for low-quality samples. For samples shipped in interstate commerce 10 grams should probably be used.

In view of our results, the committee recommends the use of five grams for analyzing brome-grass instead of the usual ten grams.

The detailed data on which this recommendation is based have been published in the 1939 and 1940 Proceedings of the Association. -

Edith C. Higgins, Chairman

REPORT OF THE SUBCOMMITTEE ON HARD SEEDS

This is a report of progress rather than one of accomplishments. During the past year, consideration has been given to the response of hard seeds to more temperate methods of treatment than the use of sulphuric acid and scarifying which have been employed for several years, both experimentally and commercially.

As was pointed out in last year's report, the scarifying of seed to reduce the hard seed content is the only method of treatment which has been used on a commercial scale. The other methods of treatment with sulphuric acid, varying degrees of temperature, and mechanical impaction have all given promising results, but as yet have not been found adapted to use on a commercial scale.

New Methods of Treating Hard Seeds

The possibility of using rather dilute solutions for varying lengths of time to cause hard seeds to become permeable was suggested in last year's report of this subcommittee. The solutions which were mentioned were soil extracts, acids, alkalies, and ferments. While the studies with these solutions have not progressed as far as it was hoped they might, they do give considerable promise.

Another method which is receiving attention is that of scouring or polishing the seeds to reduce the impermeable nature of the seed coat without causing the sever breakage which takes place in the scarifying process. As is generally recognized, this breakage takes place in both the seed coat and embryo. There is also an effect on the seed which, while not capable of being observed by an examination of the treated seed, causes broken sprouts when the seeds are germinated.

The methods which are being studied are similar to those used in scouring wheat preparatory to milling it into flour, in dehulling rice and polishing it so that it becomes the smooth white product which is so

familiar to all, and the dehulling and polishing process which is used in making pearled barley for use in soups. It is believed that by employing some of these principles a process can be developed which will make the seed coat thinner and more permeable to water without causing severe breakage. -

W. O. Whitcomb, Chairman

REPORT OF THE SUBCOMMITTEE FOR PHYTOPATHOLOGICAL STUDIES

The subcommittee conducted a cooperative test of Nigrospora-infected corn. The objectives of the test were; (1) to familiarize the collaborators with the diseased condition, (2) to present two different techniques for the reporting of Nigrospora, and (3) to test the uniformity of these techniques as practiced by the collaborators.

Each laboratory was sent; (1) diseased material for study, (2) three small lots of corn infected with Nigrospora in varying degrees, and (3) an envelope containing a synthetic sample of corn partially infected with Nigrospora oryzae.

Of the three small lots of corn, A, B, and C respectively, lot A contained 20 kernels of corn severely infected with Nigrospora oryzae carrying an abundance of spores. Lot B contained 20 kernels of corn from an ear infected with Nigrospora but with very few spores on the kernels. Lot C contained 20 disease-free kernels. The cooperators were asked to examine these three lots of corn under a magnification of about 30x and to record t the number of kernels on which Nigrospora spores were found. The data are given in Table 1.

Each cooperator gave the same report for lot A in which 100% of the kernels were severely infected and had an abundance of spores on every kernel. In evaluating the Nigrospora on Lot B the reports ranged from 0 to 20 depending on whether a few spores per kernel were considered negligible or not. For lot C two of the six cooperators reported a few spores on these supposed Nigrospora-free kernels

A fourth envelope contained lot E, 100 kernels of a synthetic sample of corn, of which 33 were from the same source as lot A, therefore with an abundance of spores, and 67 were from the same source as lot C, which was Nigrospora free. The instructions for observation of this lot were to examine each kernel under a binocular microscope at about 10x and determine the number of kernels with and without spores.

No doubt some spores from infected kernels spread by contact to disease-free kernels. Three of the cooperators considered a few scattered spores significant and reported a high percentage of kernels with spores. The other three cooperators considered a few scattered spores per kernel as negligible and reported close to 33% as carrying Nigrospora. It is suggested that this technique of reporting Nigrospora on corn might be utilized generally if only kernels with an abundance of spores on the tip or around the base of the kernel were counted as being infected.

Another technique for detecting Nigrospora was tested. It was a method involving the culturing of the organism from the kernels. Ten to 20 of the kernels of each of lots A, B, and C were surface disinfected in 10% Clorox and planted aseptically on sterile plain agar, two or three kernels per plate. After holding the plates at room temperature for 6 or 7 days any Nigrospora-infected seed was made apparent by the growth of the fungus from the kernel. The identification of the organism was made possible by the characteristic size and shape of the spores, the spores being oblate spheroid and 10 to 18 microns in the greatest diameter, and by comparison with a culture that was sent for that purpose.

Although not enough seeds were tested in this way to demonstrate the practicability of this method as a routine seed laboratory technique it is seen that each laboratory that attempted this technique was successful in demonstrating the presence of Nigrospora.

TABLE 1.-Summary of the Comparative Exercises with Nigrospora-infected Corn

Objective	Lot	Laboratory					
		Ottawa	Cal.	N.Y.	W.Va.	Mass.	Iowa
For diagnosis of the diseased corn.							
Number of seeds on which Nigrospora spores were found, 20 seeds per lot	A	20	20	20	20	20	20
	B	20*	0	1(17*)	10*	16*	1(20*)
	C	0	0	0	3	2	0
For a technique of reporting Nigrospora uniformly							
Number of seeds on which Nigrospora spores were found. 100 seeds in this lot.	E	100*	33	38(47*)	100*	0	33
For isolation and identification of the organism. (Optional.)							
Number of kernels from which isolation was attempted.	A	20	-	10	10	20	20
	B	20	-	10	10	20	20
	C	20	-	10	10	20	20
	E	-	-	-	-	100	-
Number of successful isolations.	A	20	-	10	4	12	20
	B	3	-	7	0	18	1
	C	1	-	0	0	3	0
	E	-	-	-	-	84	-
Whether the spores from the isolations checked with those sent in culture for comparison		yes	-	yes	yes	yes	yes

*Includes those with traces only.

Further comparative tests are necessary before the subcommittee ventures to recommend a standard method for the reporting of this disease on corn.- W. N. Rice, Chairman; C. H. Amick, W. L. Crosier, W. H. Davis, J. W. Groves, and W. D. Hay.

REPORT OF SUBCOMMITTEE ON METHODS FOR THE ANALYSIS OF SMALL SEEDS

Four projects were undertaken by this subcommittee, all of which were a continuation of previous experiments or collaborative work conducted either by present or former members of the committee or by the general research committee within the past six years.

Analysis of Chalcis-fly Infested Seed

The first project dealt with the analysis of alfalfa and red clover seed infested with chalcis fly. The New York laboratory submitted replicate samples drawn from a low-quality lot of alfalfa seed estimated to contain about two per cent chalcis-fly injured seed. Eight laboratories, presumably experienced with this kind of seed, were asked to make an analysis. The

results showed a difference of over four per cent between the highest and lowest pure seed percentage. The major factor responsible for the variations was considered to be a difference in interpretation of what constitutes one-half a seed. The slight change in the wording of the rules pertaining to the disposition of insect-injured seeds as approved by the association at its meeting in 1941 may help to promote uniformity and members are urged to familiarize themselves with the change.

A further contribution to an experimental approach to the problem of analyzing chalcis-fly infested seed was undertaken by the Iowa laboratory member of the committee in cooperation with the Virginia and Oregon laboratories. The methods described by the three laboratories independently as published in the report of this subcommittee for 1940 were compared.

Briefly, the procedure was as follows: Fifteen subsamples were drawn from one lot of red clover and one of alfalfa each infested with chalcis fly. Each subsample was analyzed by the Iowa method which consists of blowing the sample at a series of uniform but gradually increased pressures until practically all infested seeds are removed. The heavy fraction is then examined with the binocular for any stray infested seeds which are removed and placed in the inert fraction. It is not difficult to become familiar with the peculiar appearance of infested seeds. The fraction removed at the top pressure is then examined with the binocular for any lightweight noninfested seeds which if present are placed in the pure seed fraction. No crushing of seeds is practiced, all decisions being based on appearance after experience has been achieved.

Upon completion of the analysis of the 30 subsamples the respective fractions were recombined and five each of red clover and alfalfa were submitted to the Oregon and Virginia laboratories respectively. The remainder were retained by the Iowa laboratory. Each cooperator was requested to analyze the subsamples by his respective method as published in the 1940 Proceedings. Following the analysis each pure seed fraction was then divided into three portions and each cooperator received one. All portions of the pure seed fractions were tested for germination by the respective cooperators using blotters. When sufficient seed was available sand was used.

The results of these detailed and carefully conducted tests were analyzed by the Iowa laboratory and reveal the following facts:

1. The 15 subsamples of alfalfa seed as analyzed by the Iowa method gave percentages of purity such that the probability value for all was .20 indicating homogeneity of the samples. Similarly each 5 subsamples analyzed by the Virginia and Oregon analysts appeared to be homogeneous when analyzed by the respective procedures.

2. A further test of homogeneity is revealed in the germination results. The P value for the 15 pure seed fractions provided by the Iowa method was .60, indicating a satisfactory degree of uniformity. The P values for the pure seed fractions provided by the other two methods were .03 and <.01 respectively, indicating less homogeneity which may be caused in part by differences in interpretation.

3. In comparison with the official method the results of this test indicate that either of the three procedures gave more uniform results and in spite of the small differences in germination secured by the three laboratories their results in both purity and germination are more uniform than have been obtained with such seed by different laboratories using the official method.

The data obtained from the red clover tests show much the same situation as above discussed for the alfalfa with three exceptions: (1) On the basis of germination each of the 15 sets of pure seed fractions shows a satisfacotry degree of homogeneity, (2) The percentages of pure seed reported

by the Oregon analyst are not sufficiently uniform and (3) the mean percentages of purity obtained by the Iowa analyst are lower than those reported by the other two analysts. This may be accounted for by the fact that the Iowa method removes insect-injured seeds detectable by appearance and weight regardless of size. The slight reduction in purity, however, is compensated by the higher germination for the 15 pure seed fractions from subsamples 1 to 5 than for either of the other two sets so that index values would be similar.

A logical conclusion from this series of experiments is that either of the three procedures gives more uniform results than the application of the official method has given and that further experiments and comparisons among a larger group of analysts should be made.

Orchard Grass Seed

The second project dealt with orchard grass seed and was conducted in a manner similar to that of the chalcis-fly project in that three methods of analysis were compared with the official method. The methods were the direct as developed by Musil, the fractional, by Woodbridge and the Iowa, by Seiferle and Porter. Articles dealing with each of these methods may be reviewed in past published Proceedings.

The Iowa member of the committee drew from a lot of orchard grass seed 16 subsamples, each weighing approximately two grams and analyzed each by the Iowa method. The separations were recombined (the Iowa method for orchard grass is such that the same sample can be used for future analysis) and 4 subsamples were submitted to the laboratories at Washington, D. C., Beltsville, Md., and Geneva, N. Y., for analysis by the direct, the official and the fractional methods, respectively. Each cooperator then subdivided each of his four pure seed fractions into four portions, retained one portion for himself and submitted one each to the other three cooperators for a germination test. The results of this carefully planned experiment were analyzed by the Iowa laboratory and show a comparison and evaluation for the four methods with each percentage of germination representing a mean of four replicates.

The percentages of purity by the Iowa method for the 16 subsamples show a uniformity which is almost too pronounced, in fact, most lots of orchard grass will show more variation among subsamples. The percentages of purity for samples 9, 10, 11 and 12 (official) and 13, 14, 15 and 16 (fractional) are likewise uniform, though about 2% less than by the Iowa or modified method.

Inasmuch as each set of 4 subsamples represents a purity analysis by one method it is fair to check the homogeneity, (1) for a given laboratory for each set of 4, and, (2) for the four laboratories on subdivisions from the same pure seed fraction. In the first case, out of 16 comparisons, there are four in which the probability is less than .05. In the second case there are 10 out of the 16 in which the probability is less than .05, indicating a considerable lack of homogeneity, which again may be caused largely by methods of testing within a laboratory, as well as some lack of uniformity among the several subdivisions from the pure seed fractions.

Analysis of the data as a whole, Table 1, for each set of 4 subsamples shows that the official and direct methods gave fractions that were less homogeneous than should be expected and on the basis of these results may be considered less reliable than the other methods. The probability values for the 16 sets were much less than .01. The fractional method gave fractions slightly more homogeneous than the modified but the difference in Chi square values for the two was only 6 and both are below .05 in

probability for the 16 sets. The fact that pure seed fractions prepared by the Iowa or modified method are subject to change by repeated handling may well account for the small difference in homogeneity by the two methods.

TABLE 1.-Evaluation of Orchard Grass Seed by Four Methods

Method	By each lab.			Lab. Purity & all labs. germ.			
	Pure seed %	Germination %	P. x G. %	Pur. %	Mean %	P. x G. %	P
Official	84.3	85.8	72.3	84.3	83	70.0	<.01
Fractional	84.2	85.5	72.0	84.2	84.8	71.4	.04
Modified	85.9	83.8	72.0	85.9	83.5	71.7	<.01
Direct	----	375.5*	74.6**	----	377.7*	74.6**	<.01

*Mean number sprouts in .440 grams of seed.
**Pounds per hundred of pure live seed.

A final comparison may be made in time required and application of the method to seed merchandising. From the standpoint of the latter, the direct method cannot be used directly in our present system of marketing and labeling seed. Of the other three methods, the official is time-consuming, requiring from one to three or more hours per sample. The fractional should consume from one-fourth to one-third the time of the official. It has been shown experimentally that the Iowa method required from 25 to 40 minutes per sample. It is being used experimentally in the Canadian and certain laboratories in the United States. This extensive referee test suggests that the fractional and modified methods are comparable and worthy of consideration by seed analysts. Further collaborative work to compare these two methods using more variable samples should be conducted.

Climax Blowing Point for Grass Seed

In the 1940 Proceedings, page 40, C. W. Leggatt reported upon the use of progressively increased blowing pressures to obtain a maximum or climax pure live seed figure after which it would begin to increase. He has continued that work independently and has reported his findings in Contribution No. 657, from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

He concluded that the standard pure seed analysis fails to give an accurate estimate of the pounds per hundred of pure live seed of Kentucky bluegrass. He questioned the value of the time-consuming work with its accompanying interpretational error required to determine what are or are not to be considered pure seeds, when by simply carrying the usual blowing practice a little further a higher and more consistent figure is secured and greater uniformity exists because the personal factor is eliminated.

The subcommittee agrees with his recommendation that further cooperative studies and trials be made looking forward to the adoption by the Association as a whole of the principle and the practice if it can be worked out on a practical and acceptable basis.

Referee Testing

Under the head of referee work one replicated sample was circulated to the entire laboratory membership. It consisted of a synthetic sample of Poa pratensis made up of exactly 90% of pure seed and 10% of inert material mostly light-weight unfilled florets.

The results, being purely referee work, and in accordance with previous action of the Association are not herewith included for publication. They show a high degree of uniformity. There were only two instances where the results were too divergent and they were from laboratories where the workers are unfamiliar with this kind of seed. The uniformity as shown by the reports from the laboratories might be expected with a synthetic lot in which the line of demarcation between pure and impure seed was fairly well defined. There was much less chance for error than when commercial samples are used for refereeing work. The use of a synthetic lot of seed is of definite value in checking a technique or the operation of an air blast separator as well as that of a diagnosis, observation or a determination.

Further Use of the Binocular Method

The chairman recently proposed (page 81, 1940 Proceedings) a method, which for want of a better name, was known as the binocular method. It consisted of working a smaller sample very thoroughly and carefully by utilizing the binocular microscope and strong reflected light. This method was further studied this year and in circulating the general referee sample of bluegrass seed inquiry was made of workers as to what further success they had with this method. The replies showed that a few had continued to use the method and saw certain definite advantages in it. One laboratory replied that it caused eyestrain, but that did not appear to be the experience of others where adequate and properly adjusted instruments and some of the new lights were used. The validity of the size of sample used was questioned by one worker.

The experience in the New York laboratory has been that it is entirely practical, safe, and a great time saver. The results compare favorably with the more time-consuming official method. It has its greatest usefulness when used to quickly check the total pure seed percentage of a stock of seed in question.

Conclusion and Recommendations

One conclusion that may be drawn from the year's work seems to be that the membership as a whole are keenly interested in the matter of technique and practice as it affects their work but are somewhat confused by the seemingly cross currents of opinion and recommendations as to just what should be done.

It is the recommendation of the subcommittee that a few general referee samples be circulated to the entire membership and by an associate referee or someone thoroughly familiar with the kind of seed used and that the sample be very carefully selected and made to test some certain definite point or practice. These comparative tests can be made to serve a very useful educational purpose as well as for studying the technique or practices in laboratories.

It is apparent that there is a definite trend toward the utilization of new mechanical devices and lighting systems to replace much or even all of the tedious work involved in some of the present practices. These changes, if finally accepted as the recommended practice, are bound to affect the present system of commercial seed stock description. - Bette Cullinan, Chairman, A. C. Heise, Wayne Robbins, Frankie-Jo M. Torpy, and Marian Viccars.

REPORT OF THE SUBCOMMITTEE ON RANGE GRASS STUDIES

At the present time many laboratories are called upon to test seeds of native grasses. This is largely due to the reseeding projects which are now in progress. Laboratories have found it necessary to devise their own methods. The committee on range grass studies is attempting to formulate a uniform method of procedure. Cooperating state laboratories include Colorado, Kansas, Nebraska, and North Dakota, the Soil Conservation Service of Manhattan, Kansas, and San Antonio, Texas, and the Bureau of Plant Industry, Washington, D. C.

The following points are under consideration at present: species of grasses which should be included in the investigation; method of securing the working sample; size of working sample; germination procedure; purity analysis procedure.

It was decided to include the following grasses: Andropogon furcatus, big bluestem; Andropogon scoparius, little bluestem; Bouteloua curtipendula, side-oat grama; Bouteloua gracilis, blue grama; Buchloe dactyloides, buffalo grass; Agropyron smithii, western wheatgrass; Elymus canadensis, Canada wild-rye; Oryzopsis hymenoides, Indian ricegrass; Panicum virgatum, switchgrass; Sporobolus asper, tall dropseed; and Sporobolus cryptandrus, sand dropseed. Agropyron smithii, western wheatgrass, is already in the Rules for Seed Testing of the Federal Seed Act, but it appears that additional research on germination is advisable. Other species will be added as the work continues.

Relative to the method of securing the working sample, several laboratories reported that the large and small Boerner samplers appear to be satisfactory. Several species require hand mixing and sampling.

The third point has to do with the size of the working sample. All laboratories agree that the size of the working sample should be on the approximate 3000 seed-weight basis. It has been suggested that such groups as section Atheropogon of the genus Bouteloua be an exception.

The fourth point, relative to germination procedure, is perhaps the most complicated of all. Many of our native grasses fail to germinate satisfactorily. This problem can be solved only by continued research. Recent researches show that progress is being made. A bibliography is being compiled which we believe will be beneficial to seed analysts and research workers.

The final point which deals with the procedure for making purity analyses offers some problems. In general, laboratories suggest that the standard method be used. It is necessary for the analyst to be familiar with each grass in order to know just what is to be considered a pure seed unit. In some grasses it may be a caryopsis while in others it may be a spikelet or a floret.

Native grass studies are still in the developmental stage. The committee suggests that the present studies be continued with the hope that in the near future valuable contributions can be made to the testing of native grasses. - Elva L. Norris, Chairman.

REPORT OF SUBCOMMITTEE ON SAND TESTS

The membership of this subcommittee is co-extensive with that of region No. 3 and in the program for the past year the chairmen of the two have worked in closest cooperation.

It was felt that a more fundamental approach to the problem of sand

tests was needed and accordingly the first action was to make a survey of the sands in use. Eight samples of sand were sent in by as many different laboratories. These were subjected to a number of physical tests the purpose of which was to find, if possible, some physical charactistic which could easily be measured, that would give an indication of the most favorable moisture level to use in sand tests. It was found that the sands varied greatly in their characteristics but to a lesser extent in their suitability as media. One sand was believed to be definitely unsuitable. A full report of this work was sent to members of the subcommittee as a preliminary to further work which is discussed later in this report.

Without going into details of the physical tests made and of the arguments and calculations involved, we present below the simple formula which was arrived at for determining the most favorable moisture level for any given sand.

$$W = .202 \quad v = 9.62$$

Where W is the weight in grams or number of cc of water to be added to each 100 grams of sand and V is the volume of 100 grams of unpacked sand.

A lot of red clover seed carefully mixed and sampled was distributed to the laboratories of the subcommittee with the request to make sand tests according to the following procedure:

Use a 1-gill measure from a laboratory bushel weight scale. Fill gently to overflowing with sand and stroke off level. Weigh sand.

1 gill (American) = 118.29 cc
1 gill (British) = 142.86 cc

The appropriate volume in cc divided by the weight times 100 gives the volume of 100 grams of sand.

Multiply this by 0.202 and subtract 9.62 to get the number of cc water to add to each 100 grams of sand. All weights, of course, should be metric.

Sufficient sand should be thoroughly mixed with the calculated amount of water before planting. Place enough sand in the bottom of the box so that after levelling carefully and compacting slightly by dropping the box two or three times on a firm surface, there will be a 1/2-inch layer of sand. Plant the seed with careful spacing and cover with another 1/2-inch of the sand repeating the levelling and compacting process. The boxes should then be placed on wet blotters and covered with wet blotters and put in a 20°C germinator. No water need be added to the sand during the test, but keep the blotters damp.

We have found such tests ready to count at 5 days, again at 7 and final count at 10 days.

Ten laboratories cooperated in this phase of this project and the results obtained are given in Table 1.

These results are highly satisfactory, the Chi-square test for homogeneity having given a value of P = .45 and the four stations which did blotter tests averaging within 0.28% of the mean of sand tests. Not only do they indicate that uniform results can be obtained but that the method of determining the most favorable moisture level can be used without difficulty.

Since the principle object of this study was that of sand as a medium, the sample of red clover seed used was chosen with few abnormal sprouts in order to avoid complicating the issue. It is recommended that in subsequent work of this subcommittee seed should be used which has been artificially aged by graduated heat or other treatments. This has the advantage

that the condition of the material can be controlled which is not possible when dependence must be placed on naturally poor seed.

The optimum moisture content of the sand appears to be determined by such factors as convenience of manipulation, the proper degree of firmness after compacting, etc., rather than the actual requirement of the seed for water. Tests carried out in the laboratory of the chairman on flax showed it to germinate equally well in sand initially carrying 4.5% moisture and varying percentages up to 10.5%. The sands were, however, somewhat different to manipulate at different percentages.

TABLE 1.- Results of Germination Tests on a Lot of Red Clover Using Technique Described Above

Germination, abnormal sprouts, dead seeds, and hard seeds, observed in

	Sand		Blotter			
Station	Germ. 10 days %	Abnormal sprouts %	Germ. 5 days %	Abnormal sprouts %	Dead seeds %	Hard seeds %
Geneva	79.0	1.8	80.0	9.0	0.0	11.0
U. S. D. A.	76.3	3.2	--	--	--	--
Toronto	76.8	2.5	--	--	--	--
Sackville	76.3	5.2	--	--	--	--
Iowa	72.3	2.2	--	--	--	--
Seed Res. Ottawa	75.0	1.0	76.0	2.5	3.0	18.5
Montreal (1)	75.8	5.2	75.8	5.0	2.0	17.2
" (2)	76.3	4.2	--	--	--	--
Maine (retest)	74.5	3.8	74.0	4.3	4.2	17.5
N. Hampshire	80.3	1.5	--	--	--	--
Ottawa	75.8	2.0	--	--	--	--
Mean	76.2	3.2	76.4	5.2	2.3	16.1
X^2	9.90^4	--	--	--	--	--
N	10	--	--	--	--	--
P	.45	--	--	--	--	--

In conclusion the chairman would like to express his appreciation and thanks for the cooperation accorded by the participating laboratories without whose help and careful work such a project is impossible. -

C. W. Leggatt, Chairman

REPORT OF SUBCOMMITTEE ON THE STUDY OF VIABILITY OF INJURED WEED SEEDS

Dorcas Hooker, Chairman

When the request came to assume the chairmanship of the subcommittee on the Study of Viability of Injured Weed Seeds it seemed that it would be well to get an expression from as many laboratories as possible as to what weeds they found especially difficult to separate according to the ruling "That undeveloped and badly injured weed seeds (including noxious weed seeds) which, upon visual examination, are clearly incapable of growth should be considered inert matter and not weed seed." As a result of a circular letter asking for this information, several replies indicated not only particular interest but also a desire to do research on the problem.

Assignments were then made and work has been accomplished on most of them. A few members found they were unable to make reports because of lack of time or material.

Those appointed were requested to follow their own ideas as to procedure, and as a consequence most of the work was directed toward first an attempt to establish the optimum temperatures for germination of good seeds, and second, an attempt to germinate seeds separated into degrees of injury and immaturity. Conclusions for establishing rules of interpretation are still in the process of being formed, and the committee has only one recommendation to make which is given as No. 4 in the recommendations of the research committee.

The chairman of the research committee suggested that whenever possible the reports be accompanied by drawings or photographs. This was done by a few members. It seems very worthwhile for this type of work to be given definite attention by the laboratories since illustrations will be a great help in interpretation of this as well as of other problems.

The reports received follow:

Report of Work on

JOHNSON GRASS, CRABGRASS, WILD MORNING GLORY, YELLOW STAR THISTLE

By Bess Cowly and Birdie Towers, Sacramento, California

As a part of the work of the subcommittee considering the interpretation of the rule for placing injured weed seeds in the inert material, the writers have been studying five of California's most troublesome weeds, namely, Holcus halepensis, Digitaria sanguinalis, Salsola kali, Convolvulus arvensis, and Centaurea solstitialis. Of these the Salsola kali material proved to be unsatisfactory and the results are not included in our report. Material for the other four kinds was taken from samples of commercial seed received in the laboratory during the last year and the injuries are due entirely to cleaning machinery, and the physical deficiencies to immaturity.

Each kind of weed seed was considered in the light of its own injured seeds and grouped as seemed most suitable. These groupings are shown in figures 1 to 4 and are listed in the respective tables, hence repetition is unnecessary.

The satisfactory germination secured in the tests with the normal seed (classification #1) of all four kinds indicated that the tests were made under laboratory conditions favorable to germination. No photographs were taken of these germination tests.

The germination tests of Digitaria sanguinalis, Convolvulus arvensis, and Centaurea solstitialis were conducted at 20°C on blotters in a germinator. The normal caryopses (in glumes) of Holcus halepensis were tested in petri dishes at room--35°C and the unhulled and injured on blotters at 20-35°C.

Seedlings classified as weak were considered as incapable of producing a plant in the soil under favorable conditions.

The results of these tests are shown in tabular form as follows:

1.-Holcus halepensis - Johnson grass

Class	Description	Number of caryopses tested	Germination	
			Normal %	Weak %
1-1	Normal caryopses in glume	100	72	-
1-2	Normal caryopses without glume	100	79	-
1-3	Caryopses with slightly injured embryos	50	8	4
1-4	Caryopses with embryos badly injured - less than one-half	25	0	0

2.-Digitaria sanguinalis - Crabgrass

Class	Description	Number of seeds tested	Germination	
			Normal %	Weak %
2-1	Normal caryopses in glumes	100	93	-
2-2	Normal caryopses without glumes	100	62	3
2-3	Caryopses with slightly rubbed embryos	100	15	3
2-4	Caryopses with more than one-half of embryos present	75	0	0
2-5	Caryopses with less than one-half of embryos present	10	0	0

3.-Convolvulus arvensis - Wild morning glory

Class	Description	Number of seeds tested	Germination		
			Normal %	Weak %	Hard Seeds %
3-1	Normal seed	100	11	-	79
3-2	Broken seed	25	4	12	-
3-3	Somewhat immature seeds, almost normal in size but not filled out	100	12	-	11
3-4	Immature seeds, smaller than those in 3-3, and collapsed	50	0	2	-
3-5	Very immature seeds, small and shriveled	50	0	0	-

4.-Centaurea solstitialis - Yellow star thistle

Class	Description	Number of seeds tested	Germination	
			Normal %	Weak %
4-1	Normal seeds - both types	100	82	-
4-2	Decorticated seeds but embryos apparently uninjured	100	63	12
4-3	Decorticated seeds with embryos apparently injured	100	19	30
4-4	Seeds with seed coats broken but embryos apparently uninjured	25	40	20
4-5	Seeds with seed coats broken and embryos apparently injured	50	24	18

The results of the studies for 1940-41 show that group 1-4 (Holcus halepensis), and groups 2-4, and 2-5 of Digitaria sanguinalis and group 3-5 of Convovulus arvensis respectively were incapable of producing normal sprouts.

Fig. 1.- Uninjured and Injured Seeds of Holcus halepensis

Fig. 2. - Uninjured and Injured Seeds of
Digitaria sanguinalis

Fig. 3.-Uninjured and Injured Seeds of
Convolvulus arvensis

Fig. 4. - Uninjured and Injured Seeds of Centaurea solstitialis

Report of Work on

PLANTAGO SPP.

Faye McCoy, Ohio

Kind and condition	Germination		Year collected
	Sprouts %	Dead %	
P.lanceolata - broken seed	8	92	1940
P.lanceolata -	0	100	Old seed--20 yrs.
P.rugellii -	0	100	Old seed--20 yrs.
P.rugellii - shriveled	0	100	1940
P.rugellii - immature	2	98	1940
P.aristata - broken seed	15	60	1940
P.aristata - new seed	69	31	1940

"Daylight greenhouse germinator and room temperature throughout the 22 days with an average temperature of 20-30°C."

Report of Work on

BUCKHORN PLANTAIN (Plantago lanceolata)

Verna Jane Thompson, Ames, Iowa

"Screenings" containing buckhorn plantain seed were obtained from seed companies. These seeds were then classified into three groups; brown and plump (good seeds), brown and shriveled, and black and shriveled.

The first tests were made to determine the optimum temperature for the germination of buckhorn seeds. Plump seeds were used for these tests.

Fig. 1.- Illustration of buckhorn seeds and seedlings as listed in Table 2. Left, No. 1; center, No. 2; right, No. 3. Lower views before germination, (20X); upper views after germination, (left 8X), (center and right 10X).

The results are given in Table 1, showing that an alternation of temperatures of 20-30°C was the most favorable. Using these temperatures a test was made on the three classes of seed. The results are shown in Table 2, and illustrated in Fig. 1.

TABLE 1. - Germination of Buckhorn Plantain Seeds at Different Temperatures

Lot	No. seeds	Germination at three temperatures		
		20°C %	20-30°C %	30°C %
1	200	19	24	10
2	204	54	65	45
3	206	77	79	41
4	208	87	89	61

TABLE 2. - Comparative Germination of Three Classes of Buckhorn Seeds, 20-30°C.

Condition of seed	Class	Germination %
Brown, plump	1	86
Brown, shriveled	2	17
Black, shriveled	3	0

The evidence obtained confirms earlier tests in that black, shriveled buckhorn seeds are nonviable and brown shriveled seeds are low in vitality. Those brown shriveled seeds with no luster are similar to the black shriveled ones.

Report of Work on

NORMAL DODDER SEEDS

Rose Poehlman, Columbia, Missouri

Seeds of normal dodder were counted into sets of 2 x 100 each and germinated as follows:

No. 1 & 2, between blotters at 20°C constant.
No. 3 & 4, between blotters at 20-35°C.
No. 5 & 6, between blotters at 20-30°C.
No. 7 & 8, concentrated H_2SO_4 was added with a medicine dropper to glass vials containing the seeds and left 5 minutes. Water was added, and the H_2SO_4 washed off by placing cheesecloth over the vials and leaving them under a stream of tap water for 30 minutes. The seeds were removed from the vials to dry blotters, dried, and placed between wet blotters to germinate at 20-30°C. This treatment resulted in a slight swelling of the seeds and the removal of seed coats from some of the seeds.
No. 9 & 10, 70% H_2SO_4 was added with a medicine dropper to the vials containing the seeds and left 15 minutes. The seeds were washed for 30 minutes and dried on blotters, then placed between wet blotters and germinated at 20-30°C. At the end of this treatment most of the seeds looked slightly gray.
No. 11 & 12, the seeds were treated with 70% H_2SO_4 for 30 minutes, washed for 30 minutes, dried on blotters, and placed between wet blotters to germinate at 20-30°C. This treatment resulted in the removal of some of the seed coats and a slight swelling of the seeds.

The sprouts were counted at intervals of 2 or 3 days for the first month, then at intervals of a week until the 116th day when the tests were terminated and the seeds that remained firm were counted. The data are as follows:

Series No.	Treatment	Temperature C	Germination %	Firm seeds remaining %
1 & 2	None	20°	13.5	76.5
2 & 4	None	20-35°	17.5	70.0
5 & 6	None	20-30°	14.0	74.0
7 & 8	Conc. H_2SO_4 for 5 minutes	20-30°	63.0	26.0
9 & 10	70% H_2SO_4 for 15 minutes	20-30°	30.0	52.0
11 & 12	70% H_2SO_4 for 30 minutes	20-30°	55.5	37.5

Report of Work on

WILD ONION BULBLETS

C. M. Bass and Dorcas Hooker, Richmond, Virginia

The Virginia laboratory desires to present the following hypothesis for the consideration of the Association: That wild onion bulblets that do not have the "basal end" present or that have the "basal end" severely damaged should not be counted as weed seeds.

In spite of the fact that we were unable to obtain, by tests, results that would indicate our hypothesis to be correct, we expect to work towards that end and from previous knowledge of the behavior of damaged seeds believe our conclusions will be substantiated.

Formerly we obtained sprouts on bulblets taken from samples of cereals received in the laboratory from dealers. At that time we noted that the end attached to the head was apparently the growing end. (See Fig. 1)

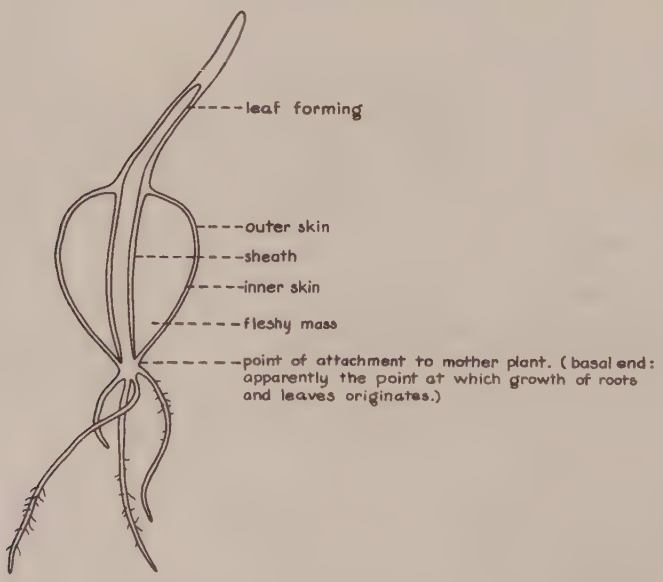
leaf forming
outer skin
sheath
inner skin
fleshy mass
point of attachment to mother plant. (basal end: apparently the point at which growth of roots and leaves originates.)

Fig. 1. - Cross Section of Sprouted Wild Onion Bulblet
Drawn by artist in Bot. Dept., Ames, Iowa

In order to prove that bulblets which had the end of attachment missing or severely damaged would not grow, the following trials were made. Whole, undamaged bulblets were cut in half, longitudinally and vertically, and placed to germinate at the established optimum temperature (20-30°C). From these it was hoped to get sprouts on the "bottoms" and none on the "tops" of those cut vertically. No sprouts were expected from those cut longitudinally.

Tests on entire, undamaged bulblets from the same material as used for the above tests were conducted at the same time. No sprouts were obtained from any of the undamaged, whole bulblets or from the mechanically damaged bulblets. This is probably accounted for by the condition of the bulblets used. Some were freshly gathered in the field at the time of the blooming period and some were obtained from screenings which had been fumigated.

Unfortunately, even though wild onion bulblets are very abundant in Virginia, we have been unable to get exactly the right material for this work.

By experimenting with material of different ages we hope to establish the point of relative condition of whole bulblets at which we can expect to get sprouts. When this is found we will know when the bulblets will be ready to be used for mechanical damage. More work is to be done on this from time to time.

The hypothesis ventured is merely a venture, but we are very much in hopes that it will lead to experiments by analysts who are interested in this problem, and have the time to devote to it.

GERMINATION OF GREEN FOXTAIL SEEDS

By A. C. Heise, Winnipeg, Canada

Seeds (caryopses of green foxtail) were classified with four groups as shown in Table 1. Seeds of each class were tested on top of blotters at 20°C in the dark and 30°C in the light. The seeds were treated with .5% Ceresan to prevent mold from overrunning the substrata. Before planting, each of the seeds was examined separately under a binocular to separate accurately those that were completely undamaged, those slightly damaged, those hulled with uninjured caryopsis and those which showed any injury whatever to the tip of the embryo end of the caryopsis.

TABLE 1. - Germination of Injured and Uninjured Seeds of Green Foxtail by Classes

Year	Sample No.	Glumes on, Not injured		Glumes cracked		Glumes absent Fruit undamaged		Glumes absent Embryo tip injured	
		N. %	Ab. %	N. %	Ab. %	N. %	Ab. %	N. %	Ab. %
1940	4221	85.5	3	-	-	45	19.5	12*	0
	6396	33.5	2.5	2*	10	17*	0	-	-
1941	2293	-	-	-	-	37.5	43	17	36
	2341	93	1	81	14	23*	14	.5	1
	3426	87.5	4.5	80	10	24.5	23	5	6.5
	3675	95	5	-	-	61.5	19	25*	0
	3784	93.5	2	76*	20	75*	17	-	-
	Mean	81.3	3.0	59.8	13.6	40.5	22.6	14.9	8.7

*Less than 100 seeds used.

The results of the tests are given in Table 1 from which it may be seen that the naked fruits with some damage to the embryo gave only about 15% normal seedlings.

Comment: It would be helpful if seeds with injured embryos could be further classified into those with (1) only the tip end broken and (2) those with half or more of the embryo missing. The use of Ceresan for treating weed seeds is open to question because our interest is in determining how capable weed seeds are of producing plants without protection. Germination of the seeds in sand or soil should provide a measure of their ability to produce normal seedlings. - R. H. Porter

GERMINATION OF SEEDS OF AGROPYRON SP., (PROBABLY QUACK GRASS) AND THLASPI ARVENSE, PENNY CRESS

Regina B. Schulte and Pauline Balbach, Lafayette, Ind.

Seeds of Agropyron were obtained from unscarified and scarified seed lots. They were classified into four groups as shown in Table 1 and tested in blotters for 14 days at 20-30°C. The results of the tests tend to confirm the work of others in that dehulled caryopses of Agropyron as

TABLE 1. - Germination of Injured and Uninjured Seeds of Agropyron Sp. (All thought to be quackgrass)

Lot or Sample	Normal sprouts by classes							
	Glumes present		Glumes absent		Glumes absent Embryo slightly injured		Glumes absent Embryos more injured	
	Seeds No.	Nor. Spts. %	Seeds No.	Nor. Spts. %	Seeds No.	Nor. Spts. %	Seeds No.	Nor. Spts. %
1 - From alfalfa seed	400	87	1600	46	30	3	-	-
2 - From sweet clover	-	-	-	-	600	8	-	-
3 - From scarified seed	400	95	150	57	400	7.5	150	4
4 - From gravity mill--sweet clover screenings	-	-	200	62	800	22	600	4
5	25	88	190	16.3	-	-	90	0
6	-	-	-	-	600	21	200	1

found in commercial seed are very low in vitality. Those with slight and with more marked injury to the embryo produced from 0 to 4% normal seedlings. It thus appears that about 25 such seeds are equal to one normal seed in viability. A division of injured seeds into two or more classes according to the degree of injury to the embryo is desirable. The different degrees of injury are shown in Fig. 1.

The tests with seeds of penny cress are of interest in that normal seeds appear to be dormant. Removal of the seed coat results in prompt germination. Such seeds, unless broken, appear to be highly germinable.

Fig. 1. - Dehulled Fruits of Quack Grass Showing Different Degrees of Injury to the Embryo (See Table 1)

TABLE 2. - Germination of Injured and Uninjured Seeds of Penny Cress, Thlaspi arvense

Sample	Normal sprouts by classes			
	Seed coat absent		Seed coat present	
	Seeds No.	Normal Sprouts %	Seeds No.	Normal Sprouts %
1	150*	96	200***	13
2	400**	94	400***	16

*Removed by cleaning machinery

**Removed by sandpaper

***Ungerminated seeds appeared fresh - probably dormant

VIABILITY OF INJURED SEEDS OF *Avena fatua* L.

E. R. Clark
U. S. Department of Agriculture, Lafayette, Ind.

The viability of injured weed seeds is of importance to the seed analyst in purity analysis since the official rules leave much to the judgment of the analyst. Regulations regarding purity analysis in the administration of the Federal Seed Act provide that "badly injured weed seeds.... which upon visual examination are clearly incapable of growth shall be considered inert matter and not weed seeds." Whether the removal of the hull in weed seeds of the grass family seriously affects the viability has been a matter of some interest. Stahler (2)[1] reported studies with quack grass seeds which indicated at least an indirect relationship between the proportion of dehulled seeds and the percentage of germination; the greater the proportion of dehulled seeds, the less the germination. In studies of timothy, Goss (1) obtained results with 171 samples in which 17% more of the unhulled seeds germinated than the seeds with hulls removed. Whitcomb and Hay (3) found no differences in the germination of cultivated oats with hulls intact and those which had been dehulled in the threshing process, when they were compared in laboratory tests, but in field tests there was an average difference of 32% in favor of the unhulled seeds.

Wild oats frequently are dehulled in threshers and in clover seed hullers and scarifiers, and are found in poorly-cleaned commercial lots of sweet clover and flax seed. To test the viability of dehulled seeds of wild oats showing varying degrees of injury, preliminary experiments were conducted at the Federal-State Seed Laboratory at Lafayette, Indiana, with six lots of wild oats obtained from the spring-grain-producing ares of Minnesota and North Dakota.

Pure samples were obtained by handpicking normal seeds of wild oats from wheat, oats, and barley screenings. Each lot of wild oats was subjected to the action of a small sweet clover huller and scarifier until approximately 50% of the seeds had been dehulled. Then the seeds were separated into four separates as follows:

1. Unhulled seeds. The hulls showed torn edges and tips but the caryopses were not exposed.

2. Dehulled seeds, with caryopses uninjured or slightly damaged. The base of the embryo was not "skinned" or broken, and much of the pubescence of the outer coat remained on the caryopsis.

3. Dehulled seeds with the embryo showing moderate injury. The base of the embryo showed distinct abrasure, with the outer coat rubbed off from one-fourth to one-third of the surface of the embryo. The pubescence had been polished from the seed coat.

4. Dehulled seeds with the embryo severely injured. The outer coat had been scraped from more than one-third of the surface of the embryo and t the surface of the endosperm was smooth and polished.

Germination tests of each of the four separates of the six lots of wild oats were made in sand and in paper towels, at the standard temperature, 20°C. These tests were made from 30 to 90 days after the seeds had been subjected to the hulling treatment.

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[1] Numbers in parentheses refer to literature cited.

TABLE 1. - Germination of Dehulled and Unhulled Seeds of Avena fatua L.

Percentage of Sprouted Seeds in 10-Day Test Period

Sample No.	Unhulled Uninjured %		Unhulled Seed coat torn %		Dehulled Little or No injury %		Dehulled Moderate injury %		Dehulled Severe injury %	
	S*	T**	S	T	S	T	S	T	S	T
1	72	68	88	82	70	50	20	4	0	2
2	77	81	87	85	66	64	20	34	0	0
3	66	65	82	78	84	82	24	-	2	1
4	-	-	93	94	62	82	30	26	0	0
5	-	-	-	97	34	-	-	-	0	0
6	-	-	85	92	76	74	60	72	1	3

*S = sand test.

**T = paper toweling.

Germination readings at the close of the ten-day period are given in Table 1. Germination results from the original unhulled seed (with lemma and palea in the normal position and condition) of Lots 1, 2, and 3 also are given in the second column of this table.

The third column gives the readings on the unhulled portions which had been subjected to the action of the clover huller. It will be noted that this portion germinated somewhat more than the original unhulled seed, ranging from 78% to 88%, while the original unhulled seed germinated from 65% to 81%. These differences may be due to the action of the clover huller in slightly loosening the caryopses from the lemmas and paleas, leaving these coverings somewhat torn and frayed.

Five lots of seed (i.e., 1, 2, 3, 4, and 6) gave germination readings of from 78% to 94% with hulls intact, and from 50% to 84% when dehulled and only slightly injured. Lot No. 5 was damaged severely by the huller and produced only 34% sprouts in the dehulled seed. Lots 1, 2, 3, and 4 germinated 4% to 34% when the caryopses were moderately injured and from 0 to 2% when the caryopses were severely injured.

Lot No. 6 was less injured in the hulling process and all separates except that with the embryo severely damaged germinated 60% or more.

The results of these limited trials seem to indicate that dehulled seeds of Avena fatua germinate very poorly if the embryo shows appreciable abrasure at the base. Seeds with the embryo scraped or "skinned" over as little as one-fourth of the area of the surface showed very low germination. Loosening the hulls (lemma and palea) by rough treatment in the thresher or in a huller seemed to improve the viability. However, once the hull has been removed, the base of the embryo is easily injured and serious loss of viability usually occurs.

Literature Cited

1. Goss, W. L. Germination of Hulled and Unhulled Timothy Seeds as They Occurred in Samples Received at the Seed Laboratory. Proc. Assoc. Off. Seed Anal. 1915: 21. 1916.
2. Stahler, L. M. Preliminary Work on Germination of Agropyron Caryopses. Proc. Assoc. Off. Seed Anal. 1935: 56-59. 1936.
3. Whitcomb, W. O. and Hay, W. D. Notes on the Germination of Broken Seeds. Proc. Assoc. Off. Seed Anal. 1924: 38-39. 1925.

VIABILITY OF INJURED WEED SEED, *Bromus tectorum*[1]

Louisa A. Kanipe
Oregon State College, Corvallis, Oregon

The relationship of the different degrees of injury to viability of weed seeds is significant in the accuracy of seed testing. In 1940, seeds of *Bromus tectorum*, downy brome, were chosen for study. Special emphasis was placed on mechanical injury found in commercial seed.

Bromus tectorum seeds were removed from commercial samples of *Agropyron cristatum*, crested wheatgrass of the 1940 crop. They were classified somewhat arbitrarily, according to the extent of their apparent injury. Normal seeds were divided into two groups, those having the lemma and palea (Plate IA) and those having no lemma and palea (Plate IB). Seeds having breaks in the embryo were treated as injured seeds and were divided into five groups, based on the extent of injury, as follows: (1) slight break at the tip, apparent only upon very close examination (Plate IC); (2) more than one-half of the embryo present (Plate ID); (3) one-half or less of the embryo present (Plate IE); (4) embryo broken to the scutellum (Plate IF); (5) scutellum partially removed (Plate IG).

When seeds were found in which a part of the embryo was broken out leaving a thin layer extending beneath the position of the embryonic seedling, damage was classed according to the break in the embryo proper (Plate IF). No consideration was given to seeds broken so that the complete embryo was removed as it is self-evident that they would not produce a plant.

Ten seeds from each group were removed from the individual samples and placed to germinate at 20-30°C in petri dishes on paper toweling moistened with water. Seedlings from each group were counted and classified in the following manner; (1) normal vigorous seedlings (Plate IIA); (2) seedlings with normal appearance but lacking in vigor (Plate IIB); (3) seedlings having various types of abnormal plumules or roots or both (Plate IIC); (4) seeds producing only an abnormal plumule (Plate IID); (5) seeds not entirely dead but showing only very weak growth (Plate IIE). Only seedlings in groups (1) and (2) were considered as being capable of continuing their growth to produce plants. When either the plumule or root is badly damaged, it is unlikely that a plant will result. The other groups of sprouts were definitely incapable of rurther growth.

Correlating the physical appearance and viability of the various groups (Table 1), it appears that normal seeds with lemma and palea present give complete germination while seedlings produced by seeds without lemma and palea show a tendency to somewhat weakened and reduced in viability. Seeds with a slight injury at the tip of the embryo show a marked reduction in germination, dropping to 62%, estimated to be able to produce plants. Seeds having more than one-half of the embryo present show a greater number of abnormal sprouts and a definite loss of viability with a rating of only 34%. The group of seeds with one-half or less of the embryo are mostly dead, and produce only 2% of possibly good seedlings. Seeds with embryo broken to the scutellum and the group of seeds with scutellum partially removed give no evidence of growth.

It appears from the foregoing results that seed of *Bromus tectorum* having more than one-half of the embryo present should be counted as sound seed, while those having only one-half or less of the embryo present can safely be considered inert matter.

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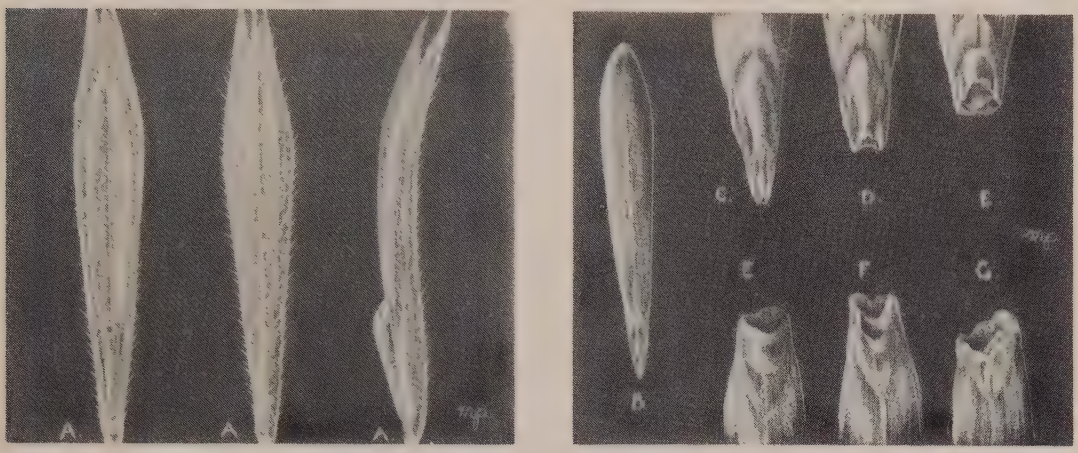
[1]Published as Technical Paper No. 385 with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution of the Department of Farm Crops.

PLATE I

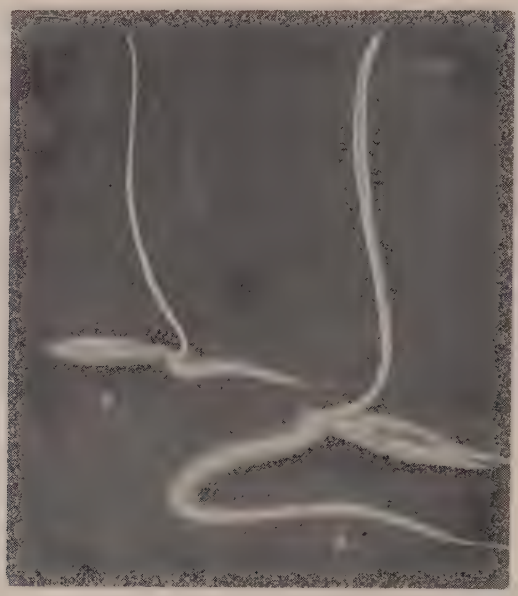


(A) Normal seed with lemma and palea
(B) Normal seed without lemma and palea
(C) Very slight break at the tip of the embryo
(D) Embryo more than one-half present
(E) Embryo one-half or less present
(F) Embryo broken to the scutellum
(G) Scutellum partially removed

TABLE 1. - Germination of Seeds of Bromus tectorum Showing Various Degrees of Injury

Groups classified by extent of injury	Type of growth	Germination counts on the 10 seeds tested					Estimated ability of seedlings to to produce plants	
		Sample numbers						
		770 No.	780 No.	817 No.	878 No.	879 No.	Probable %	Unlikely %
Normal with lemma and palea	Normal	9	10	10	10	10	100	--
	Weakened normal	1	0	0	0	0	--	--
Normal without lemma and palea	Normal	9	9	10	6	8	92	--
	Weakened normal	1	0	0	0	2	--	--
	Very weak	0	1	0	1	0	--	--
	No growth	0	0	0	3	0	--	8
Slight break at tip of embryo	Normal	4	5	9	5	8	62	--
	Injured plumule or root	2	3	1	0	2	--	--
	Plumule only	1	0	0	0	0	--	--
	Very weak	3	0	0	2	0	--	--
	No growth	0	2	0	3	0	--	38
Embryo more than one-half present	Normal	3	1	2	0	8	34	--
	Weak normal	1	1	0	1	0	--	--
	Injured plumule or root	3	1	1	0	0	--	--
	Plumule only	1	3	6	1	1	--	--
	No growth	2	4	1	8	1	--	66
Embryo one-half or less present	Normal	0	0	0	0	1	2	--
	Plumule only	1	0	1	1	0	--	--
	No growth	9	10	9	9	9	--	98
Embryo broken to the scutellum	No growth	10	10	10	10	10	--	100
Scutellum partially removed	No growth	10	10	10	10	10	--	100

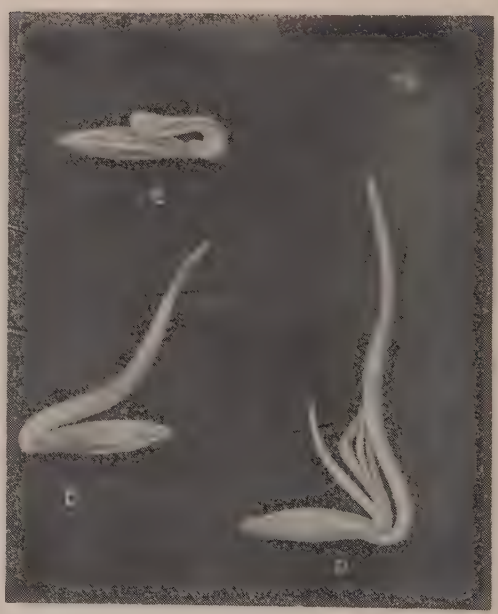
PLATE II



(A) Normal sprout

(B) Weakened normal sprout

(C) Injured plumule or root



(D) Abnormal plumule only
(E) Very weak sprout

RECOMMENDATIONS OF THE RESEARCH COMMITTEE

Four recommendations were made as follows:

1. That a renewed effort be made to organize region No. 4 in 1941-42 on a basis similar to that in other regions.

2. That the subcommittee on analysis of brome grass be discharged as having completed its work in a satisfactory manner and that its conclusion be referred to the rules committee for consideration and possible adoption by the association. The conclusion reached is that five grams of brome grass seed be used for a purity analysis instead of ten as now recommended.

3. That the subcommittee for the analysis of small seeds study further the fractional method and the Iowa modified method for the analysis of orchard grass seed with a view to the adoption of one or the other or both as approved methods.

4. That the chairman of the subcommittee on viability of injured weed seeds and the chairman of the research committee cooperatively prepare and illustrate an article for the Handbook covering the available information to date relative to the viability of injured weed seeds with due credit to those who have contributed to our present knowledge.

CONCLUDING STATEMENT

With the exception of region No. 4, the regional organization which was inaugurated in 1937 has been quite successful. The subcommittees organized to work on special projects have achieved rather marked success and have been able to consider certain specific problems in more detail than is possible for the general committee. A total of seven such committees have been organized and each has made valuable contributions. The subcommittee on the Relation of Phytopathological Techniques to Seed Laboratory Practice was established as a permanent part of the Research Committee.

Some of the achievements worthy of mention are as follows:

1. The use of sand as a medium for the evaluation of normal seedlings has received attention not only by the sand subcommittee but by some of the regional charimen. The results are encouraging in that sand offers some hope of being a more uniform medium for evaluating seedlings than blotters. More laboratories are now experimenting with and using sand than heretofore. One laboratory uses sand almost exclusively for the large-seeded crops.

2. A modified method for the analysis of small-seeded grasses developed by the Iowa laboratory has received attention by the association members and by commercial analysts. Experiments along a similar line of effort by the Canadian seed research laboratory at Ottawa have largely confirmed the reliability of the basic principle on which the separation of good seed and chaff is based. Certain collaborative work indicates that the method is more productive of uniform results than the present "official method." The method is now in use in certain laboratories in Canada and the United States for bluegrass and orchard grass seed. Further extension of the method is expected. Two new air blast separators have been made available by which air pressure may be controlled.

3. It has been shown that five grams of brome grass are quite reliable as a working sample for analysis. For low-quality samples the saving in time by the use of five grams is of great importance.

4. The use of one-half gram samples of redtop for determining percentage of pure seed has been shown experimentally to be reliable and permits a considerable saving in time. Inasmuch as the same tolerance formula

applies to both redtop and bluegrass and a half gram of redtop usually contains more particles than one gram of bluegrass it should be safe on theoretical grounds alone to use a half-gram of redtop seed for purity analysis.

5. Work with chalcis-fly infested red clover and alfalfa seeds has resulted in the development of three similar methods which appear to give uniform results in both purity analysis and germination tests. Either of the three is superior to the official method insofar as uniformity is concerned. The modification in the rules to include insect-injured seeds half or less in size with the inert fraction is intended to take care of this problem.

6. Progress in the classification of injured weed seeds and determination of their viability has been made. The results have made it possible to initiate the preparation of an article for the handbook which should serve as a guide to analysts in the interpretation of the class into which injured weed seeds should be placed. A change in the rules concerning the classification of certain weed seeds as inert material in 1937 was effected following recommendation by the research committee.

7. Information on the value of impermeable seeds in crop production has been summarized and recommendations have been made by which such seeds have been classified into three groups according to the degree that they contribute to the stand the year they are sown. Alfalfa has been placed at one extreme with all the hard seeds counted as equal in field value to germinable seeds and sweet clover at the other extreme with one-third of the hard seeds of the same value as germinable ones.

8. Progress in the determination of normal seedlings in sweet clover and alfalfa seed in a more uniform manner has been made.

9. Certain mercury dusts applied to diseased cereal and vegetable seeds have been shown to facilitate the interpretation of normal seedlings in a more uniform manner than when untreated seed is used.

10. Increased interest in research, collaborative and referee work has been evidenced and all analysts have shown a disposition to overlook small differences in interpretation to the end that more uniformity may result.

11. Marked progress has been made in the application of statistical methods to seed testing with the result that evaluation of data and measurement of significant differences has been made more reliable.

12. A new concept of pure seed in certain species of grasses has been proposed which basically depends largely on specific gravity rather than on the old botanical conception of a seed. Application of this concept to seed testing may eliminate many of the differences caused by personal interpretation and thus result in greater uniformity. - R. H. Porter, Chairman

REPORT OF THE SEED COUNCIL OF NORTH AMERICA

The Seed Council of North America, of which L. A. Moore, Springfield, Illinois, is President and E. D. Holden of Madison, Wisconsin, is Secretary, held its annual meeting Tuesday, December 3 at the Morrison Hotel, Chicago. Upon the invitation of the International Crop Improvement Association, a joint meeting was held. The attendance was unusually good and some very interesting subjects were presented.

The first address was presented by H. E. Reed, Assistant Chief of the Agricultural Marketing Service, U. S. Department of Agriculture, on the "Suggested State Seed Law," copies of which have been distributed to the various state laboratories. The second paper was presented by E. D. Holden on "The Limiting Factors in the States." W. A. Davidson presented an

interesting paper on "New Developments in the Enforcement of the New Federal Seed Act." L. A. Moore spoke on "The Uniform State Seed Lae," and developed many interesting points during the discussion.

The Association of Official Seed Analysts was represented by your President. Other members of the Association present were C. A. Stahl, L. A. Moore, W. A. Davidson, and R. C. Kinch. C. N. McIntyre.

THE PROGRAM

REPORT OF THE PROGRAM COMMITTEE

At the meeting of our Association in Auburn, Ala., in 1940, action was taken whereby the retiring president serve as chairman of the program committee with the assistance of the president and vice-president and two other members of the Association. The committee for 1941 consisted of C. N. McIntyre, F. A. McLaughlin, W. A. Davidson, A. C. Heise and the chairman.

The executive board approved the suggestion that the meeting in 1941 be conducted in part as a school. Plans were made in accordance with that action and the printed program is the result. It should be noted that most of the committee reports will be completed the first day leaving the major part of three days for classes in seed identification, seed germination, statistical methods, demonstrations with air blast separators and special methods for the analysis of grasses. A considerable number of exhibits including hard seeds, noxious weed seeds of many states, seed cleaning machinery, seed-borne organisms, seed treatments, injured weed seeds and data charts have been prepared for the attention of the analysts. The committee considers this program an experiment which if successful might well be used as a guide for future meetings.

It is hoped that the entertainment and recreational provisions in the program will meet the needs of both analysts and guests.-

R. H. Porter, Chairman

The Program of the School

Classes in seed identification were held as follows:

Agrostis species, Albina F. Musil
Agropyron species, Clara Fuhr and Edith C. Higgins
Brassica species, Albina F. Musil
Festuca and Lolium, M. T. Munn
Poas and miscellaneous crops and seeds, Emma F. Sirrine
Solanum and Physalis, Wild Oats and False Wild Oats,
W. H. Wright and Regina B. Schulte
Sorghums, Sudan and Johnson Grass, J. W. Zahnley,
Elva A. Norris and R. C. Kinch
Soybeans, W. A. Davidson

Demonstrations and Panel Discussions

Air blast seed separators and study of samples
Wayne Robbins, M. L. Spracher and C. W. Leggatt
Fractional and modified methods for Orchard Grass
Bette Cullinan and Wayne Robbins
Counting of sprouts from germinated samples
G. P. Steinbauer, W. H. Wright and W. C. Pfaender

PRESIDENTIAL ADDRESS

C. N. McIntyre
State Department of Agriculture
Columbus, Ohio

THE ANALYTICAL HORIZON

By a casual glance at the addresses of former Presidents, I find that considerable time has been aptly spent on the formation of rules for seed testing, types of equipment most satisfactory for the purpose, certification of laboratories, recommendations for continuous research, formulation of uniform laws and labels, training of the analysts and the development of state programs. Too much cannot be said of the valuable contributions to science and seed testing by such able workers as Henry, Sirrine, Hillman, Stevens, Wright, Munn, Leggatt, Porter and many others too numerous to mention. Agriculture and this Association owes much to the untiring efforts of these people during the past thirty-three years of the life of this Association. The accomplishments of these people are History and can be read by all, but WHAT ABOUT THE FUTURE?

During the past years, we have held a chair in the International Seed Testing Association. Unfortunately, last year the International meeting was cancelled because of unstable world conditions. Today, the picture is much darker. Our associates abroad may now be the opponents of democracy --not because of their own volition, but by force of circumstance. Certainly we cannot expect them to contribute much to the knowledge of seed testing for years to come. It seems, therefore, that future progress in seed testing rests with this Association. Because of the relation of seed testing to agriculture, our responsibilities are greater than at any time in our history. Future leadership must necessarily come from the younger members and associates of this organization. We should encourage these younger members and associates to take a more active part in the affairs of the Association. This responsibility naturally rests upon the officers and the chairmen of the different committees. I most heartily urge a recognition of this potential leadership.

There must be greater cooperation of all members so that the affairs of the Association may be conducted more efficiently. Naturally this statement is not directed to any individual. I realize that our first duty is to our local responsibility, yet, if we are to function efficiently, we must give freely of our time. Perhaps part of our local function can be sacrificed for the good of the whole. In any organization, the payment of dues, although absolutely necessary for the support of the work, can never replace the contributions which the members can make personally.

We must have a real desire to cooperate freely with all agencies interested in or related to the traffic of seed. We should know more about their problems, and they should know more about ours. Today is the day of specialization and I believe that we could help dealers to know more of the recommendations of the experiment stations so that they may stock and merchandise those seeds which will be in the interest of better agriculture. This is especially true where adaptation and production are important factors.

The evolution of seed testing since 1908 has been slow but sure. The advancement has been somewhat parallel to that of the automobile and later the radio and many other developments, each of which has had its humble beginning with an idea no larger than that of Nobbe. One needs but to look around to see the changes that have come about in our lifetime. Along

with this mechanical development, there have been many mistakes in design and construction, all of which have contributed to a better product. This same has been true of seed testing, but I feel that not one of us will object to constructive criticism, for by the test of time, we will correct our own mistakes. It is natural to expect that we shall continue our various programs with increased vigor and that we shall continue to foster sensible, practical legislation in order that it may be equitably and effectively administered.

It has been stated that this organization is essentially a scientific body, but it seems to be that the scope of the work is much larger than this field alone. If, however, it is essentially a scientific body, ways and means must be devised to apply it to the field of agriculture. I am somewhat inclined to believe that if the Association has faltered, it has been in the line of bringing to the consumer the knowledge of the value of seed testing. Recently, my attention was called to a situation existing in one of the states which has been making an honest effort to abide by the rules, foster uniform laws, prepare labels and which, by its own words, seemed to fulfill all that was desired, only to find out, through contact with the man on the soil, that he knew little about the program. Perhaps this situation is even greater in our own state where the laboratory is not connected with an extension service.

Many of you have already read in the News Letter, the question, "Why do hen eggs sell better than duck eggs?" The answer is really simple, and in the language of the farmer, it is stated that when a duck lays an egg, she gets up and waddles away; but when a hen lays an egg, she cackles and cackles - thus calling attention to her accomplishment. She believes in advertising her product. What are we doing to make the affairs of the Association more practical to the field of agriculture? Perhaps this omission is more apparent to those in the field of administration than to those engaged in laboratory technique.

In the early beginning, the program was to protect the farmer against the middle-man whose sole motive was profit. Today, the middle-man, in many cases, has become a seed processor. Great strides have been made in seed-cleaning methods, and such dealers are studying and advancing faster through the knowledge of seeds than the consumer. This is the natural result of closer cooperation of the seed interests. Our farmers are not conscious of the value of this service, and we must devise ways and means of getting this information to them. Today's competition and practical laws plus efficient laboratory service, guarantee the delivery of high quality seed to the consumer. However, to be able to take advantage of this situation, he must know how to read labels intelligently and apply the information to his problem. I am of the opinion that this is what former Secretary of Agriculture Wallace had in mind when he addressed this group in 1937 and urged us to carry more information to the consumer. It is the program of the public service committee that commands my especial attention. It is through this committee that we must cackle--loud enough and long enough to cause the program to receive the attention that it deserves. When this program is understood by farmers and dealers, considerably more money will be appropriated for this work.

It has been reported that one county agent, working alone in one of the central states, has caused more than twenty-five per cent of better grade seeds to be used than has previously been sown in that section. Certainly the programs that have been undertaken in Indiana, North Carolina, South Dakota and perhaps elsewhere are examples of the type of education needed to render maximum efficient service.

It has been stated by no less a person than Abraham Lincoln that, "Public sentiment is everything. With public sentiment, nothing can fail; without it, nothing can succeed. Consequently, he who molds public opinion goes deeper than he who enacts statutes or pronounces decisions. He makes statutes and decisions possible or impossible to execute."

As acting editor of the News Letter, I have already pointed out, in my brief report, the value of this publication.

Although I have attained the pinnacle of honor in this Association, it is my hope that I have not reached the pinnacle of usefulness to the Association. It is my earnest desire to continue working for the cause in any capacity, large or small.

In conclusion, I would like to have you consider the possibility of improving this organization by appointing a permament Editor for the News Letter who has the time, equipment and desire to engage in this type of work. Perhaps financial remuneration could be considered as a part of this suggestion. This same thought might be extended to the office of Secretary-Treasurer, so that such person can be spared the embarrassment of being elected against his personal desire or of being forced to resign because of pressure of other duties.

May I urge you on to greater service. In this way, we will be doing our bit for the preservation of American ideals and the democratic way of life.

THE OFFICE OF THE PRESIDENT AND ITS RESPONSIBILITIES

The responsibilities of the president generally include more than merely presiding at an annual meeting. The office naturally entails maintaining good relationships with the various seed interests and convention bureaus, especially when he, as a representative of this Association, is called upon to take an active part in the program of other assemblies. Perhaps one of the best ways that your president can serve your organization is to attend meetings of other organizations - so far as his time and facilities permit. It is with this thought in mind that I relate some of the activities of the president during the past year: An invitation from the Indiana Wholesale Feed Dealers was accepted. Some time later, an opportunity was afforded to visit the state seed laboratory in South Carolina. The next function attended was as a representative to the North American Seed Council at Chicago. Subsequently, an invitation was received and accepted to attend a meeting of the Southern Seed and Fertilizer Control Officials held in Lexington, Kentucky.

The president must coordinate the work of the various chairmen in order that the benefits which accrue become those of the Association, rather than the individual. Active contact with the members of the Association is absolutely essential, and this does entail a considerable amount of correspondence which, if to be of value, must be promptly executed. The problems must be faced as they arise and it is quite probable that the activities of one president may entail a greater amount of responsibility than that of another.

It is my sincere hope that I have served you well.

SUMMARY OF REMARKS AT THE MEETING FROM THE SEED TRADE

J. H. Withey, Northrup, King and Company, Minneapolis, as representative of the American Seed Trade Association, expressed the appreciation of that Association for the annual opportunity of meeting with the Official Seed Analysts Association.

In his brief remarks Mr. Withey reviewed a few of the changes in American agriculture of the past 20 years, calling attention to the fact that the official seed analysts and the American seedsmen had made substantial contributions to the progress of that period. Mr. Withey mentioned that 20 years ago there were many problems that confronted both the Analysts Association and the Seedsmen's Association. Some of them had been solved by individual and mutual efforts. Some of the problems of 20 years ago had in the course of time not seemed so important as they first appeared. Mr. Withey stated that some of the old problems still remained, together with new ones, and he mentioned a condition which merited the very serious consideration of the official seed analysts. During the past 20 years the average quality of farm seeds passing through commercial channels had steadily improved, a condition which was entirely due to the combined efforts of the official seed analysts and American seedsmen. It was a fact, however, that during the same period the average quality of clovers, alfalfas and other farm seeds as produced on the farm had steadily declined. This was due to many factors, including the habit of farmers in producing areas to plant their poorest seeds or to sell them locally, and to the increased use of the combine which made profitable the harvesting of seed acreages of marginal and below-marginal qualities.

Mr. Withey stated that a considerable proportion of present-day production of clovers and alfalfas could not be cleaned to a satisfactory quality of seeds according to the standards of analysts or seedsmen. This substantial production of unsatisfactory qualities, while closed to the regular channels of commerce, still merited consideration because there was no utility in seed except for seed purposes, and that these poor qualities of seed eventually found their way back to the soil.

He mentioned that the AAA planting program, which in many cases made no stipulations concerning the quality of seeds used on AAA acreages, contributed to the problem by encouraging the use of poor, unrefined seeds either on the farm where produced or in the locality of production.

Mr. Withey stated that the problem of improving the quality of seeds used in production areas and adequate control of farm seeds sold outside commercial channels was one of the most serious that confronted the official seed analysts and American seedsmen.

As chairman of the seed laboratory committee of the A. S. T. A., Mr. Withey mentioned the cooperative arrangement between the A. S. T. A. and the seed laboratory of the Iowa State College, stating that this arrangement was initiated to provide a standard reference laboratory for A. S. T. A. members in their own dealings and to have a laboratory where research problems of particular interest could be initiated and aided by the A. S. T. A. Beyond this and the fact that the Federal Seed Law necessitated increased laboratory facilities for the seed trade, Mr. Withey stated that one of the ambitions of the A. S. T. A. was that this laboratory arrangement would result in a closer association between seedsmen and seed analysts.

Mr. Withey expressed the hope that the official seed analysts would give this cooperative arrangement their sympathetic interest and support, and that the results would be so satisfactory that a similar arrangement would be undertaken with other laboratories in other parts of the country.-

R. H. Porter

THE NEW IOWA SEED LAW

Harry D. Linn
State Dept. Agriculture, Des Moines, Iowa

The topic assigned me today is a discussion of the new Iowa seed law. The new seed law was passed by our last legislature and became effective on the first of July. The passage of the law was brought about by the united effort of all organizations in Iowa interested in seeds and crops. The farmers' organizations such as the Farm Bureau, Farm Grange and Union, the seed trade, Iowa State College and our own department were a few of the interested organizations supporting the new seed bill.

Iowa people are becoming increasingly "soil conservation" conscious and the inroads of weeds on the soil's fertility and productivity has for a number of years alarmed farm folk. These good Iowa farmers are proud of the record of Iowa in the field of agriculture. They know that Iowa has within its borders 25% of the grade A land of the nation. They realize that Iowa produces 19% of the corn grown in the United States. They are advised that 8% of the national farm income is in Iowa and that the soil of Iowa produces more wealth each year than all the gold mines of the world. Thus when these good people find the weed problem growing and realize the wealth is being robbed from our soils and crops by these weed pests, I am not surprised that they advise a law to help control this problem.

The new Iowa seed law in part is much like the old law. The new law, however, defines the primary noxious weed seeds and secondary weed seeds and, in my opinion, is more easily understood than was the old law. This new law classifies the primary noxious weed seeds of the state as, quack grass, Canada thistle, perennial sow thistle, perennial pepper grass, European morning glory, horse nettle, leafy spurge, and Russian knapweed. The secondary noxious weed seeds are classed as, wild carrot, sour dock, smooth dock, sheep sorrel, butterprint, mustards, cocklebur, buckhorn, and the dodders.

This classification is practically identical with that set forth in the old statute with the exception that Buckhorn (which, as you know, spreads only from seed) is dropped from the primary weed class and added to the secondary weed class and the wild oat is omitted from the secondary class, whereas in the old law it was listed as a secondary noxious weed seed. The cocklebur is added to the secondary class.

This new law prohibits the sale of seed containing primary noxious weed seeds above certain tolerances. This also is a change from our old law which legally permitted the sale of seed containing one primary noxious weed seed per five grams of practically all of our seed, such as timothy, redtop, clover, etc., or one in twenty-five grams of millet, rape, flax, etc., and one in one hundred grams of wheat, oats, rye, barley, etc. Thus we find the new law much more severe in the case of primary noxious weed seeds. This new law allows up to five secondary noxious weed seeds per ounce of bluegrass, timothy, white clover and seeds of like size and three seeds per ounce of ryegrass, meadow fescue, red clover, sweet clover, etc.; one seed per ounce of proso, sudan grass, etc., and five seeds per pound of wheat, oats, and other seeds of a similar weight and size.

If more than the above given number of weed seeds are found in a sample the seed must be so labeled, giving the name of such secondary noxious weed seed that appears in the sample.

In discussing this law with different groups at a number of district meetings this spring, the only criticism we found to the law was that some

of the farmers thought all secondary noxious weed seeds in a certain sample should be noted on the label.

The new law gives our department the power to issue or attach stop-sale orders on lots of seed that the inspector may find containing the primary noxious weed seeds. This provision in the law should operate much like a similar provision in the Illinois law and will permit our inspectors to tie up bad lots of seed until an accurate analysis can be run on the seed and until the seed has been rendered fit for legal sale. The old law had no such provision and we were continually embarrassed by loads of bad seed being trucked into the state and sold before an accurate test could be made. I remember one such instance where our inspector found a truckload of bad seed in southeastern Iowa. He sampled the seed and warned the driver or owner that such seed could not be sold legally in the state. The driver, however, moved on to another locality and it was several days later before the inspector found him again. He again warned him but had no evidence that he had been selling the seed. This happened several times in southern Iowa and later in the season the inspector again found this same man offering seed for sale over in the cyclone and hail area of Harrison and Shelby counties. This new law would make it possible for the Department, through its inspectors, to stop-sale or tie up such bad lots of seed. Under this stop-sale provision the seed could not be moved until it had been properly cleaned and released by the Department. We believe this provision of the law will be of material help in its enforcement.

The new law requires certain labeling on seeds. The labels must show:

(1) The commonly accepted name of each agricultural seed in excess of 5 per cent of the whole and the percentage by weight of each.
(2) The lot number or other identification.
(3) The origin, if known, of alfalfa and red clover. If the origin is unknown that fact shall be stated.
(4) The percentage by weight of all weed seeds.
(5) The name and approximate number of each kind of secondary noxious weed seeds per ounce in the case of some seeds and per pound in the case of others, when present in excess of certain tolerances.
(6) Percentage by weight of agricultural seeds other than those required to be named on the label.
(7) Percentage by weight of inert matter.
(8) For each named agricultural seed (1) the percentage of germination exclusive of hard seed, (2) the percentage of hard seed, (3) the calendar month and year the test was completed to determine such percentage.
(9) Warning as to danger from poisoning in the case of treated seed if the compound used is poisonous to man or farm animals
(10) Name and address of the person who labeled the seed or who sells, offers or exposes said seed for sale within Iowa.

The new law brings the farmer under the labeling provisions of the Act. Should the farmer sell the seed through any carrier or establishment he must come under all the provisions of the law as they would apply to any other firm or individual. If a farmer sells seed on his farm, either in bulk or in containers he may be exempt from the detailed labeling provisions of the law. However, he must display either a placard giving the following information or he must furnish the purchaser with a written or printed statement on which this information is given:

This label must give:

(1) The percentage germination of the seed being sold, together with the calendar month and year said seed was tested to determine the percentage.
(2) Kind and number per ounce or pound of all secondary noxious weed seeds in the lot, if in excess of certain tolerances.
(3) A guarantee that no primary noxious weed seeds are present, subject to certain tolerances.

This provision of the law is a marked improvement over our old law which exempted the farmer on seed that was sold on his farm. In other words, the old law exempted seed when sold by one farmer to another and delivered on the vendor's premises with the exception, however, that the seed thus sold could not contain seeds of primary noxious weeds in violation of the general provisions of the law.

The new law should give the farmer a much better guarantee as to the seed which he plants. Of course, our inspectors cannot inspect all seed sold by farmers in Iowa, but the provisions in the law make it necessary that one farmer supply another with a written or printed statement or display a placard giving the information necessary for a guarantee to the buyer and should this provision of the law not be lived up to the buyer can certainly demand it and thus make sure that he is obtaining a proper seed.

In Iowa the Department of Agriculture is largely a regulatory body. In other words, we are enforcing laws given us by the legislature. In passint these laws the legislature has done so with the idea that they are fair and workable. In enforcing the law we try to the best of our ability to so interpret laws that are given us. Education is always extremely necessary and desirable to the proper enforcement of our laws, hence our efforts depend largely upon the College and the Experiment Station for educational work.

I want to say here that the cooperation our Department had received from Dr. Melhus, Dr. Porter, Mr. Sylwester and others in the Botany Department has been very helpful to us in the enforcement of the seed and weed laws. I am certain the state is fortunate in having two departments working so closely together. I imagine one of the reasons for this fine cooperative work, as I stated at the beginning of my talk, is because we are all proud of the Iowa soil and of Iowa's rank as an agricultural state, all of us here in Iowa want to conserve and build up this soil which is the principal wealth of the state.

DISCUSSION OF STATISTICAL METHODS FOR SEED ANALYSTS

One of the problems which seed analysts constantly face is the interpretation of results either when replicates from the same lot are compared or when different methods are employed with seed from similar lots. It is often important to determine if differences are significant or otherwise and if lots of seed appear to be homogeneous.

The discussion of this subject was led by R. G. Cochran, Professor of Statistics at Iowa State College. He was assisted by C. W. Leggatt of Ottawa, Canada, and R. H. Porter of the Iowa seed laboratory staff. A brief résumé of the presentation follows:

Test for Homogeneity in Seed Germination Tests
By R. G. Cochran

In germination tests, different samples from the same batch of seed are sometimes tested independently to discover whether the laboratory

technique gives consistent results for the percentage of germinated seeds. In such cases, even if the technique is satisfactory, successive tests will not agree exactly in the percentages obtained. However, if the technique is completely standardized, so that every seed has an equal chance of germinating, the amount of variation to be expected between different samples can be worked out theoretically. From this result a test, known as the X^2 (chi-squared) test, has been devised for examining whether the results from different samples are homogeneous. This test is widely used in many branches of research, and is described in most modern text-books on statistics.[1] The calculations necessary for making the test are illustrated for the example below. The only equipment needed is a table of chi-squared,[1] though a table of squares and a computing machine will save time if available.

Data. Nine samples, from the same lot of seed, each containing 400 pure seeds of bluegrass, were tested for germination on top of sand at the Iowa laboratory, (R. H. Porter's data, 1939.) The percentage germination in each sample is shown in column 2 of Table 1.

TABLE 1. - Calculation of X^2

Sample No. (1)	Germination (2) %	Difference from mean (3)	Square (4)
1	86.0	+1.0	1.00
2	85.8	+0.8	0.64
3	86.8	+1.8	3.24
4	84.0	-1.0	1.00
5	84.5	-0.5	0.25
6	85.8	+0.8	0.64
7	84.0	-1.0	1.00
8	82.5	-2.5	6.25
9	86.0	+1.0	1.00
Total or Mean	85.0		15.02

The calculations are as follows:

Step 1. Add the nine percentages, and divide by nine, to get the mean percentage, 85.0 (foot of column 2).

Step 2. Write down in column 3 the difference between each percentage and the average percentage. For sample 1, e.g., 86.0 - 85.0 = 1.0.

Step 3. Write down in column 4 the square of the corresponding number in column 3. Thus, for sample 2, $(0.8)^2 = 0.64$. Find the total of these squares (15.02).

Step 4. Multiply the mean per cent germinated (85.0) by the mean per cent failed (15.0) = 1275.0. Then

$$X^2 = \frac{400 \times 15.02}{1275} = 4.71$$

where 400 is the number of seeds in each sample.

Step 5. Since there were nine samples, X^2 has eight degrees of freedom. Look up the row n = 8 in a table of X^2. For $X^2 = 4.71$, the probability lies between .80 and .70. This means that in homogeneous material, a value of X^2 as large as 4.71 would occur more than 7 times out of 10, so that the nine samples were as uniform as could be expected.

[1] Fisher, Statistical Methods for Research Workers, ch. 4; Snedecor, Statistical Methods, ch. 1; Goulden, Methods of Statistical Analysis, ch. 9.

Notes.

1. For those unfamiliar with the use of the chi-squared table, some study of it is advisable. The interpretation of the table may be illustrated by a reading from it. For eight degrees of freedom (n = 8), X^2 has the value 15.507 in the column headed "Probability .05." This means that 5 times out of 100 (or once in twenty trials), X^2 will exceed the value 15.507 in sampling from homogeneous material.

2. Notice that the final result of the calculations is a probability; that is, the test does not say definitely that the material is or is not homogeneous, but gives merely the probability that the observed amount of variation could have arisen from homogeneous material. If, however, the probability is very low, it is reasonable to assume that the test was not completely standardized. As a conventional criterion, many workers use either a probability of one in twenty (.05) or one in a hundred (.01) in deciding whether to regard the results as homogeneous or not.

3. The general formula for X^2 is

$$\frac{s\Sigma(P - \overline{P})^2}{\overline{PQ}}$$

where s = number of seeds tested in each sample; $\Sigma(P - \overline{P})^2$ = sum of squares of the differences between each percentage germinated (P) and the mean percentage germinated ($\overline{P}$); $\overline{Q} = 100 - \overline{P}$ = mean percentage failed. The number of degrees of freedom (n) in using the table of X^2 is one less than the number of samples.

4. When X^2 is so large that the tests cannot be regarded as homogeneous, a reference to column (3) of Table 1 will indicate those tests which deviated most from the average. This information is sometimes useful in attempting to discover the causes of the heterogeneity.

5. The above calculation applies only to percentages calculated from the ratios of two whole numbers. For testing the homogeneity of percentages derived from weights (as in pure seed fractions) some changes are necessary in the method of calculation.

Statement by C. W. Leggatt

In illustration of the principles outlined by Professor Cochran, the speaker referred to results of referee work in Region No. 3 which were reported in the Proceedings of the 31st Annual Meeting, Table 13, page 57. In the article in which the table is found, the chi-square test was used in order to determine whether data might be considered as coming from a homogeneous "population." If the value of P was not less than .05 it was concluded that the data probably represented a homogeneous lot; if less than .05, then the lack of homogeneity in the data may be explained in one of two ways. Either the lot of seeds was not homogeneous or else experimental (including of course interpretational) error had entered. To test whether the lot of seeds was homogeneous, the chi-square test may be applied to the hard seed data, since these are not subject to interpretational error and are little affected by minor differences in experimental conditions. This was done in the fourth column of the table, which was the column chosen for purposes of illustration on the board. The computation of chi-square was worked out in detail. The value of P being as great as .41, it was concluded that the lot was homogeneous and therefore that the other data in the table and derived from the same samples, in which P was less than .01, exhibited excessive experimental error.

Statement by R. H. Porter

Further use of the chi-square test was illustrated by the third speaker who referred to a comparison of results obtained when soil, sand and blotters were used as substrate in seed germination tests. By using homogeneous samples of seed it is possible to measure significant differences when two or more kinds of media or substrate are used and thus to conclude that such differences are caused by the substrate itself. He further pointed out that it was possible to determine how uniformly lots of seed are mixed by drawing samples from different parts or sacks of a bulk lot. If subsequent analyses for purity showed insignificant differences it could be concluded that the samples were homogeneous. Similarly it is possible to compare the germination of pure seed fractions obtained by uniform analysis of several samples from the same lot of seed and thus determine if the method provides uniform pure seed fractions. The speaker recognized that some modification of the chi-square method is necessary when percentages of pure seed derived by weight are used.

EVALUATION OF MEDIA FOR SEED GERMINATION

Verna Jane Thompson
Iowa State College, Ames, Iowa

The purpose of the investigation was to study the relative merits of blotters, sand, and soil as germination media and to determine which most accurately and uniformly measured the germination of seeds. Ten different kinds of seed commonly tested by the seed laboratory were used in this work, namely: alsike, alfalfa, flax, lespedeza, oats, red clover, sorghum, sweet clover, timothy, and white clover. Ten samples of each kind of seed were used.

The blotters used for these tests were gray germination blotters. The sand was washed builders' sand sifted through an eight-mesh screen. It was autoclaved in a steam autoclave or heated in an electric sterilizer which was heated until the coldest spot reached 70°C and was held at that temperature for three hours. The soil consisted of one part field soil and one part builders' sand mixed together, sifted through an eight-mesh screen, and autoclaved in a steam autoclave.

TABLE 1. - Comparative Results of Germination Tests of Seeds in Blotters, Sand and Soil

Kind	Number samples	Normal seedlings		
		Blotters %	Sand %	Soil %
Alfalfa	10	69.4	69.3	65.6*
Alsike	10	82.4	81.8	80.9
Flax	10	78.2	81.1	76.6*
Lespedeza	10	79.0	82.4	81.5
Oats	10	92.6	90.5	90.5
Red clover	10	82.8	81.2	78.7*
Sorghum	10	77.0	71.3	67.0*
Sweet clover	10	58.9	59.9	54.8*
Timothy	10	74.0	74.5	60.0*
White clover	10	57.5	55.8	48.8*

*Indicates important difference between sand and soil.

Pure seed was selected from each of the samples in accordance with the "Rules and Recommendations for Seed Testing" and each sample was allowed to grow in all three media for the number of days recommended by these rules.

The data presented in this paper show that the mean percentage of normal sprouts from the 100-seed samples was the highest in blotters. However, among the 100 samples there were 40 that produced a higher germination in sand, 8 of which were significantly higher. The mean percentage of normal sprouts was significantly higher in sand than in blotters for flax and lespedeza seed. The lack of consistency on the part of the blotters suggests that the classification of normal sprouts in this medium is difficult. This may be due to the fact that blotters offer no resistance to the seedling and hence more of them appear normal. It would seem that in order to be classed as normal a seedling should be capable of emerging from a medium that offers some resistance. Of the two media that offer resistance to emergence it will be noticed that the sand gave a higher germination percentage for the mean of the ten samples for all ten kinds of seed. There were a few individual samples that germinated highest in soil but the mean of the ten was never the highest in soil.

The autoclaving of soil may cause the development of toxic materials and it also changes the composition of the soil. Sand is less altered by autoclaving than soil and so is superior in this respect. It is usually possible to obtain greater uniformity of different lots of sand than for different lots of soil. Sand was found easier to manilulate when preparing the pans for the germination tests. In reading the tests the seedlings were easier to remove from the sand than the soil without breaking. This was a great aid in the interpretation of normal seedlings.

At present it would be difficult to substitute sand for blotters in all cases because of the added expense as well as time and space. One of the chief disadvantages of sand occurs in the germination of legumes because it is practically impossible to recover and count the hard seeds. However, sand is useful as an index for checking one's judgement of normal and abnormal seedlings from time to time.

VIABILITY AND GERMINATION OF SEEDS OF FIELD BINDWEED, Convolvulus arvensis L. and OTHER NOXIOUS WEEDS (Abstract)

E. O. Brown and R. H. Porter
Iowa State College, Ames, Ia.

From 1935 to 1939 inclusive, laboratory and field studies were made of the production, viability, impermeability, longevity and germination of seeds of Convolvulus arvensis L. and of other deep-rooted perennial weeds. A summary of the data and results obtained is as follows:

Bindweed plants, Convolvulus arvensis, produce an abundance of seed in seasons of high temperature and low rainfall. Periods of cloudy weather restrict blossoming and seed production.

Production of normal seedlings by freshly harvested bindweed seeds varied from 7 to 24% in the year of collection.

Impermeability in the same collections varied from 28 to 91%, and dead seeds ranged from 2 to 51% the year of collection. The range in percentage of dead seeds in lots from 1 to 72 years old was 2 to 100.

Hand picked seeds 50 years old from a lot obtained from a Belgian herbarium showed approximately 62% viability.

Germinability in bindweed seeds was found 10 to 15 days after blossoming when the moisture content was as high as 81%, and impermeability

became pronounced from 20-25 days after blossoming when the moisture content was reduced to 13%.

In immature seeds collected and stored at high temperatures, impermeability developed from to four days sooner than when allowed to mature naturally on the plants.

Immersion of impermeable bindweed seeds in concentrated H_2SO_4 for 45 to 60 minutes resulted in quick germination under favorable conditions. Concentrations of 50 and 25% for two and nine months respectively gave results equal to the concentrated acid for 60 minutes. Moist air, water and soil at high and low temperatures reduced seed impermeability to a marked extent.

As many as 48% of impermeable bindweed seeds germinated the following spring after being covered with a three-inch layer of soil in the winter months.

Impermeable seeds of bindweed retained a considerable degree of viability and impermeability for 4 years after burial in the soil at 6 and 18 inches.

Seeds of Convolvulus arvensis planted at intervals of two weeks between April 25 and September 26, 1936, germinated and produced plants at each planting. Maximum root penetration in the soil was approximately 68 inches.

Minimum, maximum and optimum temperatures in degrees C for the germination of the seeds of five species of weeds were:

	Minimum	Maximum	Optimum
Convolvulus arvensis	0.5	40	30, 20-30 and 20-35
Euphorbia esula	0.5	40	20-30 and 20-35
Lepidium draba	0.5	40	20, 20-30 and 20-35
Centaurea repens	0.5	35	20-30 and 20-35
Solanum carolinense	20.0	40	20-30 and 20-35

Horse nettle seeds that overwintered in immature berries on the surface of the soil were non-viable the following spring. Mature seeds were partially dormant, and the condition persisted for 17 months in dry storage.

Concentrations of oxygen below 21% were unfavorable for the germination of seeds of Convolvulus arvensis, Euphorbia esula and Solanum carolinense and below 10% were unfavorable to seeds of Lepidium draba. Concentrations up to 53% oxygen were favorable for the germination of seeds of all but one of the four species. Seeds of Euphorbia esula did not germinate well at concentrations above 21%.

The viability of seeds of Lepidium draba, Lepidium repens and Hymenophysa pubescens declined rapidly to almost no vitality when buried in soil for three years at a depth of 4-6 inches.

Seeds of Euphorbia esula retained their vitality well for three years at depths of 6 and 18 inches.

Seeds of Centaurea repens, C. calcitrapa and C. solstitialis in general are short lived when buried in the soil. A reduction from about 90 to 10% or less in three years was noted.

Dormancy either at the beginning of or after the seed burial test was started was prominent in seeds of Solanum elaeagnifolium and S. carolinense, but after three years of burial the dormancy had disappeared, and vitality was greatly reduced at the lower depth of 18 inches in seeds of the first species. Seeds of S. carolinense germinated 98% after three years when buried at 4-6 inches, but at 16-18 inches practically all were non-viable.

SPLIT SEEDS IN PEAS AND BEANS

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Although baldheads and snakeheads in beans are often discussed, the problem of split seeds has not received statistical attention. From the viewpoint of seed analysts importance has obviously been placed on that type of seedling which is of least significance.

It was expected that a positive correlation could be demonstrated between split seeds and baldheads in beans. Recent observations indicate that if such correlation exists it is only coincidental. Apparently those lots of beans containing split seeds in laboratory tests may also develop baldhead seedlings under field conditions. But the presence of the "splits" is only an indication that a baldhead condition exists and in red kidney beans at least, very few split seeds do, or could, ever develop into either baldhead or normal plants. An occasional transplanted split seed will produce a baldhead plant, or very infrequently a normal plant. Usually, however, when the "splits" are transferred to friable soil at one-inch depth no further growth results. Obviously then "splits" are not counted as germinated seeds since they depreciate the value of any seedstock.

A leading authority on lima beans states that not only is there little relation between splits and baldheads but that there may be but slight relation between laboratory judgement of baldheads and the actual development of this condition in the field.

During the past five years incomplete records have been kept for "splits" in peas and beans. In the past year, however, every germinating sample of peas, dry shell beans, green shell beans, snapbeans, and lima beans was examined for split seeds. In this abnormal condition both cotyledons are, or may easily be, detached from the remainder of the embryo, hence the hypocotyl in beans, or the radicle in peas, fails to develop beyond a length of 5 to 12 millimeters. At this time only a tabular summary of the occurrence and severity of split seeds will be presented. The data in Tables 1 and 2 are summaries of very accurate readings from only treated samples of peas and beans. The results from several hundred untreated tests were discarded because confusion may exist in evaluating molded or soft-rotted seedlings. It has been determined, however, from comparison of treated and untreated duplicates of perfectly clean tests that no commonly used chemical influences the splitting of seeds.

Since red copper oxide often toughens and Spergon softens the seed coats of lima beans these two materials were rejected as protectants in this study.

Although it is not the purpose of this article to present conjecture as to the cause of "splits" it appears logical to accept the common view that rapid or excessive drying of the seed and/or mechanical injury during harvesting or later processing are/is the causal factor/s.

Handling or examination of dry pea seeds usually does not enable the analyst to determine the presence of a few "splits." However, when 10% or more of "splits" develop in a germination test an experienced analyst can determine this abnormal condition in the dry seed.

A superficial macroscopic examination of bean seeds will often demonstrate the presence of cracked seedcoats or loosely adherent cotyledons. These seeds produce "splits" in a germination test but in our observations many macroscopically normal seeds will not produce normal seedlings.

TABLE 1. - Occurrence and Severity of Split Seeds in Samples of Peas

Variety	Samples			Split seeds present	
	Observed No.	Containing splits No.	%	Maximum %	Average %
Ace	20	18	90	5	2.2
Alaska	22	20	91	12	5.4
Alderman	53	46	87	13	2.3
American Wonder	4	3	75	10	0.8
Bliss	2	1	50	1	0.5
Blue Bantam	3	3	100	4	2.3
Canner's King	8	7	88	4	2.0
Champion of England	3	2	67	1	0.7
Chief	27	22	81	15	2.9
Climax	28	22	79	5	1.4
Dwarf Telephone	5	4	80	4	2.0
Early White Sugar	2	1	50	1	0.5
Famous	4	3	75	3	1.7
Gilbo	4	3	75	6	2.0
Gradus	34	19	56	9	1.5
Glacier	2	1	50	4	2.0
Laxtonian	2	1	50	1	0.5
Laxton's Progress	7	7	100	4	1.8
Little Gem	6	4	67	4	1.2
Little Marvel	4	4	100	6	3.2
Mammoth Melting	4	4	100	18	11.0
Mardelah	2	1	50	1	0.5
Marrowfat	2	2	100	4	3.5
Merit	2	2	100	6	6.0
Morse's Market	2	1	50	1	0.5
Nott's Excelsior	11	9	82	5	1.8
Onward	2	2	100	5	4.5
Perfection	45	41	97	10	2.2
Peter Pan	2	2	100	2	1.5
Prémium Gem	7	6	84	3.0	1.5
Pres. Wilson	3	3	100	1.0	1.0
Pride	12	8	67	6.0	1.9
Prince of Wales	2	1	50	2.0	1.0
Prolific Early Market	2	2	100	5	5.0
Roger's Kay	2	2	100	2.0	1.5
Sugar	7	3	43	8	2.2
Surprise	76	52	69	5	1.2
Sutton's Excelsion	3	2	67	1	0.7
Telephone	24	15	63	4	1.2
Thomas Laxton	103	68	66	6	1.4
W. E. Sweet	13	8	62	4	1.5
World's Record	4	4	100	6	3.5
Wyoming Wonder	3	2	67	16	5.7
Variety Unknown	283	236	83	13	1.9

TABLE 2. - Occurrence and Severity of Split Seeds in Varieties of Beans, Lima Beans and Soybeans

Variety	Samples			Split seeds present	
	Observed	Containing splits		Maximum	Average
	No.	No.	%	%	%
Dry shell beans					
Marrowfat	28	22	78	15	2.8
Medium	4	4	100	4	3.0
Pea	21	4	19	3	0.4
Red Kidney	116	107	92	42	7.8
White Kidney	21	18	86	13	6.6
Yellow Eye	12	11	92	11	3.5
Variety unknown	19	13	68	9	4.1
Horticultural or green shell beans					
Canada Wonder	2	1	50	8	4.0
Dwarf Horticultural	22	14	64	25	3.1
French Horticultural	4	3	75	10	4.8
Lowe's Champion	5	4	80	6	2.2
Lima beans					
Henderson	26	19	73	17	3.6
Other varieties	59	35	60	30	4.5
Snap beans					
Asgrow S. Gr. Pod	6	3	50	8	2.0
Blue Lake	5	3	60	9	5.0
Bountiful	43	32	74	11	3.4
Bountiful Black Wax	2	2	100	5	3.0
Brittle Wax	32	32	100	19	5.5
Burpee's S. Gr. Pod	64	62	97	27	7.9
Davis Wax	3	3	100	12	9.0
Full Measure	7	7	100	10	5.6
Giant Stringless	8	7	88	12	5.1
Golden Wax	49	43	88	16	5.9
Hodson Wax	2	2	100	5	4.0
Kentucky Wonder	58	52	90	18	4.8
McCaslan	6	3	50	4	2.0
Pencil Pod B. Wax	7	6	86	8	3.4
Plentiful	3	3	100	6	4.0
Refugee, Green	21	19	90	25	11.2
Refugee, Idaho	47	46	98	24	9.3
Sensation	4	4	100	22	16.7
Sure Crop Wax	9	9	100	8	4.8
Tendergreen	4	4	100	8	5.2
Tennessee Green Pod	9	7	78	8	3.3
U. S. No. 1	2	2	100	10	5.1
U. S. No. 2	2	1	50	1	0.5
U. S. No. 5	18	18	100	21	9.4
Valentine, black	12	9	75	8	1.9
Valentine, red	29	26	89	30	7.7
Wardwell wax	2	1	50	3	2.0
Webber Wax	2	2	100	3	2.5
Variety not recorded	13	11	85	34	7.1

TABLE 2. - (Cont'd.)

Variety	Samples			Split seeds present	
	Observed No.	Containing splits		Maximum	Average
		No.	%	%	%
Soybeans					
Cayuga	15	11	73	8	2.6
Manchu	11	7	64	18	2.7
Ontario	3	3	100	3	1.7
Seneca	26	12	46	9	1.9
Black Wilson	5	5	100	4	3.6

Summary

1. Split seed are considered of more importance than baldheads to seed analysts.

2. A positive correlation probably is not existent between laboratory splits and field baldheads.

3. Transplanted split seeds rarely produce any type of plant.

4. Tables are included to show the percentage of splits in varieties of peas and beans.

5. Chemicals used as protectants in the laboratory do not influence the degree of splitting.

6. Splits in beans can often be detected in the dry seed. Macroscopic examination of dry pea seeds usually fails to demonstrate splits.

SOME OBSERVATIONS IN THE GERMINATION OF GRASS SEEDS [1]

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From the annual publication of papers dealing with germination techniques of grass seed it would appear that new problems are arising continually in this field. Modifications of old methods and procedures and surveys of the results obtained by standard techniques also merit occasional consideration.

Germination of Kentucky Bluegrass

This paper presents actual results obtained in the course of routine testing and outlines the probable value of amendments of the accepted techniques. According to the "Rules and recommendations for testing seeds" [2] adopted in 1937, Kentucky bluegrass (Poa pratensis L.) should be placed in petri dishes and exposed to a daily temperature alternation of 20° and 30°C for 28 days. Exposure to light is suggested for fresh seed.

Since a special daylight germinator is available at Geneva all seeds which might require light are placed in this environment. Usually 2 100-seed lots of Kentucky bluegrass were placed on moist cotton or Kimpak in petri dishes and either 1 or 2 100-seed lots on similar substrates moistened with 0.2% (KNO_3) potassium nitrate.

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[1] Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 462.

[2] Rules and Recommendations for testing seeds. Proc. Assoc. Off. Seed Anal. 1937: 61-84. 1938.

TABLE 1. - Germination, Killed Sprouts and Fungus Contaminations of Grass Seeds Germinated at 20-30°C in Daylight

Species	Treatment	Germination %	Sprouts killed %	Fungi on seeds %
Kentucky bluegrass, 114 samples, 85 to 98%	None	90.5	1.5	11.1
	KNO_3	89.6	5.4	20.4
Kentucky bluegrass, 55 samples, 46 to 84%	None	79.1	1.0	13.6
	KNO_3	79.4	5.4	23.8
Rough bluegrass, 19 samples, 85 to 96%	None	91.3	0.9	4.4
	KNO_3	88.9	1.5	6.8
Rough bluegrass, 11 samples, 36 to 84%	None	67.0	1.2	10.6
	KNO_3	74.0	2.0	16.8
Canada bluegrass, 13 samples, 85 to 99%	None	72.2	0.9	5.8
	KNO_3	90.1	4.9	7.6
Canada bluegrass, 3 samples, 83 to 84%	None	53.3	1.0	4.3
	KNO_3	83.3	1.0	6.0
Redtop 39 samples, 85 to 99%	None	94.2	0.3	2.9
	KNO_3	92.4	0.9	4.1
Redtop 4 samples, 73 to 85%	None	81.0	2.7	8.2
	KNO_3	80.2	2.5	6.4
Agrostis spp. 35 samples, 85 to 98%	None	94.8	1.6	3.6
	KNO_3	97.6	5.3	7.8
Agrostis spp. 6 samples, 81 to 85%	None	76.5	1.4	2.8
	KNO_3	84.0	5.1	6.8
Astoria bent, 9 samples	None	93.6	0.5	1.2
	KNO_3	93.7	3.1	4.5
Seaside bent, 11 samples	None	77.4	0.2	1.7
	KNO_3	92.5	1.5	3.9
Colonial bent, 7 samples	None	88.0	0.6	2.1
	KNO_3	88.9	4.2	3.4
Rhode Island bent, 4 samples	None	92.2	0.1	0.5
	KNO_3	95.4	1.1	1.2

Observations and statistical records from 169 of these lots strongly indicate that KNO_3 is of little value in securing an accurate germination from the average sample. As the results in Table 1 show, the average percentage of normal sprouts from the seeds on KNO_3-treated substrates differed less than 1% from the controls. The greatest differences recorded were as follows: Sample 9816, treated 87%, control 76% and sample 12318, treated 69%, untreated 90%. There is but slight statistical evidence that the lower germinating lots are benefitted by amendment of the substrate with KNO_3.

Of the 114 samples containing 85% of germinating seeds or more the tests with addition of KNO_3 germinated the higher in 50 instances, lower in 53 and showed no difference from the controls in 11 instances.

The germination percentages of seeds on treated substrates varied less than 5% from those of seeds on untreated substrates for 93 samples and the differences exceeded 5% for only 21 samples.

The results from the lower germinating lots show the seeds on KNO_3-moistened cotton producing the more sprouts in 27 instances, less in 23 and no difference in 5. Variations in excess of 5% were noted in 22 of the 55 samples studied.

That KNO_3-soaked substrates tend to increase the severity of blighting in 28-day tests of Kentucky bluegrass is undoubtedly true. With few exceptions the tests on the treated substrates could be distinguished from those on untreated cotton by this characteristic alone. There is no correlation between blighting of the sprouts and the viability of a seedstock. Practically every lot carries fungus-infested seeds and under certain conditions such as addition of KNO_3 the aggressiveness of the pathogenes is increased.

Fungi on Grass Seeds

As mentioned in a former article[1] the more common pathogenes incident to grass seeds are Alternaria tenuis, Nees., Curvularia specifera (Bainer) Boedijn, Epicoccum purpurascens Ehrenberg, Fusarium culmorum (W. G. Sm) Sacc., Fusarium moniliforme Shel., Helminthosporium halodes Dresch., Helminthosporium sativum P. K. & B., and Phoma glomerata Woll. and Hochct. The legend for the illustration of these fungi is incorrect in that spores of Curvularia geniculata (L.) Boedijn were pictured under C. spicifera. According to J. E. Machacek the spores of C. spicifera are oblong and 3-septate whereas those of C. geniculata are geniculate-fusiform and 4-septate. Presumably these two species are both common to grass seeds. During the past season these species and the Helminthosporium species have caused most of the blighting of sprouts.

Modifications of Techniques for Germination of Kentucky Bluegrass

When the tests of Kentucky bluegrass on untreated substrates germinated at least 5% lower than those on KNO_3-soaked cotton the non-germinating seeds were placed on a treated substrate and the tests continued. In no instance, however, did more sprouts appear in the tests originally on water-soaked cotton unless additional seeds also germinated in the tests continuously on treated cotton.

Certain other modifications of the germination procedure such as exposure of the seeds to temperature alternations of 15-30°, 15-35°, or 20-35°C, drying before or during the tests failed to increase significantly the apparent viability of any lot.

Germination of Rough Bluegrass

Rough bluegrass (Poa trivialis, L.) responded to additions of KNO_3 if the seedstock was of low vitality. Eight of the 11 low-germinating samples were apparently benefitted by this chemical, in one instance by as much as 20%. Among 19 seedstocks with a germination of 85% or better only 6 showed an increase in sprouts when the seeds were placed on treated cotton.

Germination of Canada Bluegrass

As repeatedly proven by experimental work many samples of Canada bluegrass (Poa compressa,L.) respond to additions of 0.2% KNO_3. During the past year only 16 lots of pure Canada bluegrass were received for

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[1]Crosier, Willard and Weimer, Dolores. Some fungi associated with grass seed. Proc. Assoc. Off. Seed Anal. 1939: 120-124. 1940.

germination studies. As shown in Table 1 the average germination was increased significantly by placing the seeds on KNO_3-soaked cotton. Only 4 of the 16 samples failed to produce more sprouts on treated cotton than on water-soaked cotton. Usually by transferring the ungerminated seeds from untreated to a treated substrate after the completion of a 28-day test, a total germination somewhat approaching the actual viability of the lot could be obtained.

Germination of Agrostis spp.

Results were also recorded for the germination of several samples of Agrostis species. The response of redtop, Agrostis alba to KNO_3 is as indifferent as is that of Kentucky bluegrass. The percentage of blighted or contaminated sprouts may be increased by additions of KNO_3 but usually the tests were clean at the completion of a 10-day test. The germination of seeds in the treated substrates was greater than that of seeds on water-soaked blotters or cotton in 10 instances, less in 31 instances but in only 6 of the 43 samples studied did the differences exceed 5%.

The results from Agrostis spp. (mixtures of bents with redtop), indicate that the average sample is little benefitted by additions of KNO_3 but that all viable seeds of an occasional lot will not germinate unless this chemical is present. Twenty samples produced the highest germinations on treated cotton and 14 samples on untreated cotton. The germination of seeds on the treated and untreated substrates varied more than 5% in only 7 of 41 samples tested.

Astoria bent, Agrostis tenuis, Sibth., did not respond to amendment of the substrate with KNO_3. Slight increases over control tests were noted for 3 samples, and decreases for 4 samples which were germinated on treated cotton pads.

Seaside bent, Agrostis palustris, Huds., showed both an average and a single-sample response to KNO_3 stimulation. The increased germination on treated cotton varied from 18 to 41% in 4 samples and from -1 to 6% in 7 samples.

When the ungerminated seeds originally placed on water-soaked cotton were removed to KNO_3-moistened cotton after a 21-day test the final germination in 10 days more approximated that of the seeds held on the treated substrate for the entire 31 days. Continuing the tests on water-soaked cotton for 10 or even 20 days more rarely demonstrated a true percentage of viable seeds. As was true for other species of Agrostis requiring a germinative period of 21 days KNO_3 augmented the growth and aggressiveness of the pathogenic fungi.

None of the samples of Colonial or Rhode Island bent (Agrostis tenuis, Sibth.) benifitted materially from exposing the seeds to a treated substrate. The number of blighted sprouts was increased by KNO_3 especially when the tests were not terminated in 21 days.

Germination of Lolium spp.

Normally the germination of seeds of common ryegrass, Lolium italicum, A. Br., and of perennial ryegrass, Lolium perenne, L., is complete in 10 and 14 days respectively. Recent observations, however, indicate that a long germination may be essential to obtain an accurate percentage of viable seeds. After completion of the 10-day test on blotters, ungerminated seeds of common ryegrass were placed on KNO_3-soaked cotton. After 3 to 10 days, a few sprouts usually appeared. The average increase for the 22 samples studied is 3.75% with a range of 0 to 13% as is shown in Figure 1. Whether the addition of KNO_3 is ever, or usually beneficial cannot be

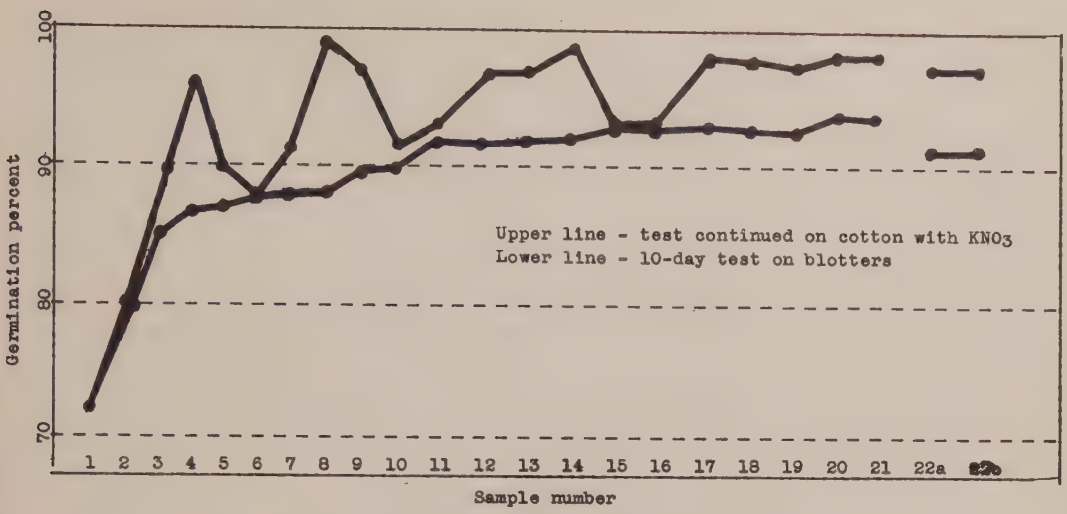
Germination percent
100
90
80
70
Upper line - test continued on cotton with KNO3
Lower line - 10-day test on blotters
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22a 22b
Sample number

Fig. 1.- Germination increases in seeds of common ryegrass obtained by prolonging the germination period.

answered positively. In a few instances seeds on water-soaked cotton responded as quickly and to the same percentage as did seeds on KNO_3-soaked cotton. In other instances KNO_3 appeared to have been helpful.

Only 18 samples of perennial ryegrass, Lolium perenne, L., were studied to determine whether or not germination was complete in 14 days. The results indicate that a 14-day test is adequate to evaluate most samples although in one instance only 83% of the seeds had germinated in 14 days. When the 17% of ungerminated seeds were transferred to KNO_3-soaked cotton, sprouts appeared from all but 2%. In a few other samples an additional 1 or 2% of the seeds germinated after the recommended 14-day period.

Reed Canary Grass

In 1938 evidence[1] was presented at the annual meeting of our association to indicate that hulless seeds of Reed Canary grass (Phalaris arundinacea, L.) are of little value. The data does not show the germination of the unhulled seeds but presumably it was not unduly low. Mention is made, moreover, that "all samples of the hulless seeds were badly attacked by mold, while the samples of unhulled seeds did not show any sign of molding."

Since the hulless seeds were placed on KNO_3-moistened substrate, molding would almost inevitably be severe if the seeds had been dehulled. The term hulless probably is applied to dehulled seeds since a normally hulless seed is not weakened or rendered artificially susceptible to attack by mold fungi. It is suggested that the word "dehulled" be used when denoting that a hull removal process has taken place and that hulless be used when a hull or hulls were never present.

In working with Reed canary grass at Geneva it appears that dehulled seeds placed on KNO_3-soaked cotton are rotted or that the sprouts are killed before they are easily counted. For instance, whereas a germination of 84%

[1] Morris, George C. Germination studies of the hulless seeds of Reed canary grass. Proc. Assoc. Off. Seed Anal. 1938: 259-262. 1939.

was secured for normal (not dehulled) seeds in one sample that dehulled seeds produced only 14% of evident sprouts. Without addition of KNO_3 to the substrate the final germinations were: normal seeds, 70 and dehulled seeds, 24%. When similar samples were protected with a 1% solution of a weak (2%) ethyl mercury tartrate dust the dehulled seeds produced at least as many sprouts as did normal seeds. It is strongly recommended that experimenters protect all dehulled seeds by an effective chemical; otherwise their results are more indicative of the action of the mold fungi than of the dehulling.

That both dehulling and KNO_3 may increase the germination of Reed canary grass was evident in one test. After 26 days on water-soaked cotton at 20-30°C only 22% of the seeds had germinated. When KNO_3 was added the germination increased to 55% in 9 days more while the seeds transferred to fresh water-soaked cotton produced a total of only 39% of sprouts. The glumes were then removed from a portion of the seeds and in only 4 days more an additional 12% of sprouts appeared. The seeds not dehulled produced only 2% of additional sprouts.

Summary

1. Potassium nitrate improved the germination of an occasional sample of Kentucky bluegrass and rough bluegrass.

2. Canada bluegrass is very responsive to additions of KNO_3 on the substrate.

3. Several fungi are common to seeds of Poa spp. and Agrostis spp.

4. Curvularia geniculata occurs with, and may be recognized as C. spicifera.

5. Most seedstocks of Agrostis spp. did not respond to additions of KNO_3. Samples of Seaside bent may not be accurately tested unless KNO_3 is present in the substrate. It is suggested, however, that all samples of Agrostis spp. (Agrostis alba excluded) be tested with KNO_3 as is now the general practice.

6. Seeds of common ryegrass which have not germinated in 10 days at 20-30°C may respond to an additional 5-day period on KNO_3-soaked cotton. Perennial ryegrass is less responsive to this procedure.

7. The terms hulless and dehulled should be correctly and informatively used.

8. All dehulled seeds of Reed Canary grass should be protected by an effective chemical.

GERMINATING SEEDS OF SOUTHERN GRASSES[1]

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Recently the use of tropical grasses have become of economic importance for soiling or pasture in many of the southern states. Samples of these seeds were received for germination tests. Some of these species were found to be very slow and difficult to germinate. In an effort to find the best method for the successful germination of these seeds a series of test conditions and methods were utilized.

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1. Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 485.

Methods of Testing and Results

Bahia grass (Paspalum notatum) and Guinea grass (Panicum maximum) seeds with the palea and lemma removed were placed to germinate in petri dishes on filter paper on cotton well moistened with 0.2% solution of potassium nitrate. These were germinated for 10 days in a daylight chamber at 15°C for 8 hours and in a dark chamber at 35°C for 16 hours of each day. These two species are very often badly diseased and the fungi they carry in most cases work through the heavy glumes to the caryopses causing a low germination. By treating these caryopses with a 1% ethyl mercuric tartrate dust, a much higher percentage of germination was obtained.

In a recent issue of the "News Letter," Alice M. Andersen suggested a "shorter method" for the germination of one of these species, namely Bahia grass (Paspalum notatum) by removing the glumes. The method she proposed has been followed in our laboratory for the past year in preparing seed of these southern pasture grasses for germination.

Germination tests of seeds of these two species without removing the glumes, but treated to prevent mold, had to be extended for the usual 30-day test period to obtain a germination as high as that obtained by the 10-day test using naked caryopses.

Observations of results indicate that removal of the glumes alone will not produce a high percentage of germination with most lots of these species. The most important factor is the alternating temperatures of 15°C for 8 hours in a daylight germinator and 35°C for 16 hours in a dark chamber. Such an alternation of temperatures is absolutely essential for the germination of every viable seed.

Dallis grass (Paspalum dilatatum) responded to the same procedure as that followed with Bahia grass. Results definitely indicated that removal of the glumes did not hasten germination nor increase the percentage of normal sprouts. Seeds of Dallis grass were placed to germinate at alternating temperatures of 20-35°C in light as prescribed in the "Rules and Regulations under the Federal Seed Act" and found to germinate 68% in 21 days, whereas the seeds placed to germinate under the method described above germinated 74% in only 14 days.

Rhodes grass (Chloris gayana) tested under both methods to determine the effect of temperature, degluming and treatment with 0.2% solution of potassium nitrate showed that the highest germination was obtained in only 6 days when deglumed seeds were treated with 0.2% solution of potassium nitrate and placed at alternating temperatures of 15°C for 6 hours in daylight and at 35°C for 18 hours in darkness. No other combination of factors produced comparable results even though the germination period was extended the usual number of days.

Mosasses grass (Melinis minutiflora) when deglumed and tested in darkness showed that the alternating temperatures of 15°C for 6 hours and at 35°C for 18 hours were not favorable for germination. Seeds tested in light at an alternating temperature of 20-30°C, moistened with a 0.2% solution of potassium nitrate, produced better results. However, it was found that by degluming these seeds then using the latter method the highest percentage of germination was obtained within a period of 10 days.

Conclusion

As a result of the work done to date the writer ventures to suggest the following methods to obtain the maximum germination with the grasses studied.

Suggested Methods

Kind of seed	Sub-strata	Temp. °C	First count Days	Final count Days	Remarks
Bahia grass *Paspalum notatum*	Petri dish, filter paper on cotton	15-35	3	10	*Deglume carefully by use of a scalpel. Potassium nitrate. Light at 15°C for 8 hours. Dark at 35°C for 16 hours. Diseased seed treat with 1% ethyl mercuric tartrate.
Guinea grass *Panicum maximum*	Petri dish, filter paper on cotton	15-35	3	10	Deglume carefully by use of a scalpel. Potassium nitrate. Light at 15°C for 8 hours. Dark at 35°C for 16 hours. Diseased seed treat with 1% ethyl mercuric tartrate.
Dallis grass *Paspalum dilatatum*	Petri dish, filter paper on cotton	15-35	5	14	Not necessary to deglume. Potassium nitrate. Light at 15°C for 8 hours. Dark at 35°C for 16 hours.
Rhodes grass *Chloris gayana*	Petri dish, filter paper on cotton	15-35	3	6	Deglume carefully by use of a scalpel. Potassium nitrate. Light at 15°C for 8 hours. Dark at 35°C for 16 hours.
Molasses grass *Melinis minutiflora*	Petri dish, filter paper on cotton	20-30	5	10	Deglume carefully by use of a scalpel. Light. Potassium nitrate.

*When degluming guard against injury to embryo.

THE PRETREATMENT OF BUFFALO GRASS FOR FIELD PLANTING
A Preliminary report

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Introduction

The "seed" or fruit of buffalo grass consists of one to several spikelets within thick overlapping outer glumes which have become hardened and fused, the whole cluster being held rigidly together by a hardened base. This structure forms a globular bur that is more or less impervious to water. In some samples these outer glumes are exceptionally thick and hard, in others fairly thin even though not evidently weathered. These conditions result in a germination that is slow and irregular, sometimes delayed for long periods. It is also possible that delayed germination may be due in

some degree to factors other than impermeable glumes. Field planting of untreated seed would consequently result in a poor stand or a complete failure.

In making routine laboratory tests of buffalo grass it was observed that seed lots differ in their germination response, irrespective of age of seed, place of origin, or time of harvest. This erratic behavior is also evident in the results reported by other investigators. Wenger[1] stated that soaking the seed in tap water for 2 to 4 days, followed by thorough drying before seeding, will largely overcome delayed germination and prolonged dormancy. Pladek[2] reported that among unweathered lots there is no increase in germination as a result of presoaking, and only in some cases of weathered lots is favorable reaction obtained. Pladek also observed that burs which are immature or mature but not weathered required a prolonged chilling period to overcome the seed dormancy, while burs that appeared weathered gave satisfactory germination either without pretreatment, by presoaking, or by prechilling.

The present study was undertaken to find a means of pretreating the seed burs to obtain prompt and maximum germination by a method that would be practical for field use.

Materials and Methods

Seed samples were obtained from the principal buffalo grass areas of the Great Plains: North Dakota, Nebraska, Kansas, Oklahoma, and Texas. The seed lots represent harvests from 1936 to 1940, taken from native pastures and from selected nursery strains. To study the germination response of seed at different stages of maturity, seed from two selected strains at Hays, Kansas, was harvested at 5 weekly intervals from June 22 to July 20, 1940, and the first germination test made in August, 1940.

The tests were made in duplicate of 100 burs each, in petri dishes on a substratum of paper toweling moistened with a 0.2% solution of potassium nitrate, and in soil. The soil was a mixture of sterilized soil and sand, moistened just enough to hold its shape when pressed lightly in the hand. The burs were placed on top of the soil and pressed down lightly. The germination tests were continued 4 weeks at the alternating temperatures of room (approximately 20°C) to 35°C. Tests were in the higher temperature 7 hours, and in the lower temperature 17 hours. At times when the room temperatures were high the tests were put in a 20°C dark chamber.

Preliminary tests indicated that prechilling the moist seed at 5°C for 6 weeks gave maximum results in most cases, and this method was used for all chilling treatments in these tests. The usual type of household refrigerator was used for this purpose. No moisture was added to either soil or toweling during the period of prechilling.

Seed to be dried before germination was stored in cloth bags in a drying chamber maintained at 40°C for a period of 6 weeks.

Samples prepared as for laboratory tests were planted in the greenhouse to observe the results under conditions that would more nearly approximate those of the field. The untreated seed and 3 different treatments of each seed lot were used for these tests; prechilling in petri-soil; and soaking the seed for 1 hour in water and in dilute potassium nitrate,

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[1]Wenger, Leon E. Soaking buffalo grass seed to improve its germination. Jour Amer. Soc. Agron. 33. 3: 135-141. 1941.

[2]Pladek, Mildred M. The testing of buffalo grass seed. Jour. Amer. Soc. Agron. 32. 7: 486-494. 1940.

draining, and prechilling damp without substratum. Prechilling in soil was accomplished by mixing the seed with the moist (not wet) soil instead of placing it on top of the soil as for chamber tests. At the end of the chilling period the soil was practically dry, and the seed together with the soil was planted in flats filled with potting soil. Duplicate tests were placed in temperatures ranging from approximately 60-75°F and 70-85°F respectively.

The burs in all tests were counted indiscriminately from the bulk. Because of the nut-like character of the burs it is not possible from a superficial examination to determine which contain no caryopses and have no potential viability. Therefore at the completion of the germination the burs remaining were sectioned to determine the number of possible viable burs and the percentage of germination was calculated on that basis. As the germinated burs were removed from the petri dishes they also were sectioned and the number of sound and germinated caryopses recorded. To this was added the record of the caryopses in the burs remaining ungerminated at the end of the tests. From this the actual percentage of germinating caryopses was determined.

Experimental Results

Tests were made of 25 different seed lots. The results of 11 representative lots are here presented. Tests of these 11 lots were started on the same day, January 1941, to insure identical conditions of soil, moisture, and temperature throughout the test.

Figure 1 shows graphically the germination response of the untreated seed and of 7 different treatments of each of the 11 lots of seed. The source and year of harvest, and the pretreatment of the seed are indicated in the figure. In evaluating the results of these tests it is believed that a variation between tests of 10 per cent or less could be due to sampling and not necessarily to a significant difference of response to treatment.

Figure 1, A shows the per cent of possible viable burs germinating, without reference to the number of sprouts per bur. Treatment 1 represents the check sample. There is no apparent correlation in results between seed lots of the same age or date of harvest as evident by the degree of weathering. One lot, No. S-15, is outstanding in that results are uniformly high in all treatments.

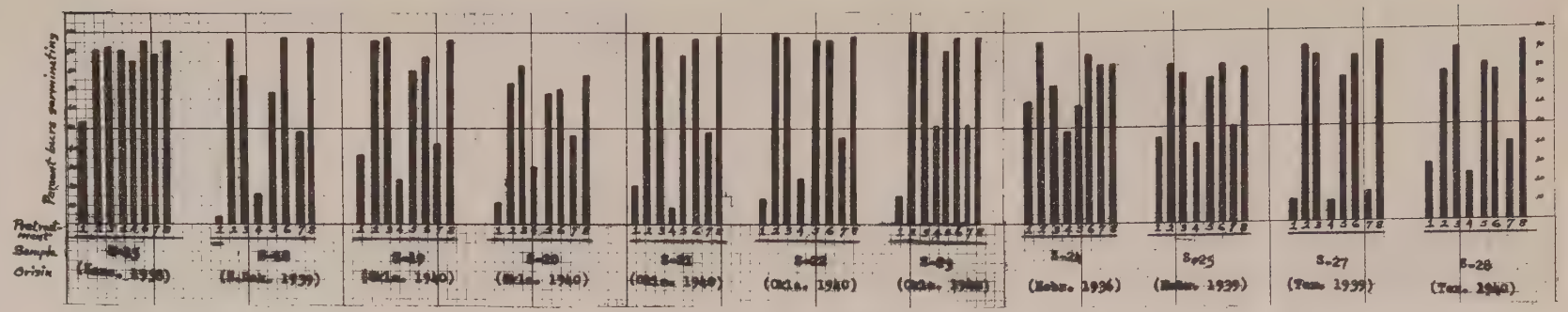
Treatment 2 represents tests prechilled in petri-soil at 5°C for 6 weeks before germinating. The results from this treatment approximate or exceed the best results obtained from any other treatment except in one case, No. S-15, which is somewhat lower.

Treatment 3 represents the same treatment as No. 2 except that a substratum of paper toweling moistened with a 0.2% solution of potassium nitrate was used instead of soil. The results with the toweling are comparable to those with soil in 8 lots, but are lower in two lots and higher in one lot.

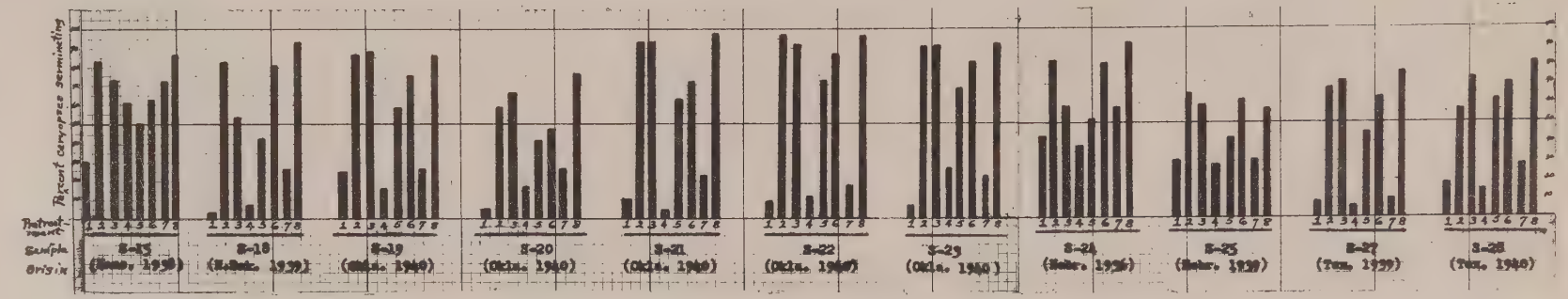
Treatment 4 shows the results from seed soaked in tap water for 72 hours, dried at room temperature for several days, then put to germinate without further treatment. This method was effective in only one case, lot No. S-15. In the other 10 lots the treatment was the least beneficial of any used in this study. The results from two of the lots are of special interest, No. S-23 (1940 seed) which was not evidently weathered, gave approximately the same response as No. S-24 (1936 seed) which was definitely weathered.

The results shown from treatment 5 were obtained by thoroughly wetting the seed by soaking in tap water 1 hour. The seed was then drained

FIGURE 1.- The effect of various pretreatments* on the germination response of different lots of buffalo grass



A - Percent of burs germinating



B - Percent of caryopses germinating

*Pretreatment

1 - None
2 - Prechilled petri-soil, 5° C, 6 weeks
3 - Prechilled petri-towels with K, 5° C, 6 weeks
4 - Soaked in water 72 hours, dried at room temperature
5 - Soaked in water 1 hour, stored damp in lightly stoppered bottle, 5° C, 6 weeks
6 - As in no. 5, but dilute potassium nitrate used instead of water
7 - Soaked in water 48 hours, dried at room temperature
8 - As in no. 7, followed by prechilling in petri-soil, 5° C, 6 weeks

and stored damp in lightly stoppered bottles in 5°C for 6 weeks before germinating. Treatment 6 represents the same procedure as treatment 5, but the seed was soaked in a 0.2% solution of potassium nitrate instead of water. In 8 lots the results obtained by the use of water and of potassium nitrate are comparable, in 3 lots the potassium nitrate was more beneficial than water.

Treatment 7 represents seed soaked in tap water for 48 hours, dried at room temperature for several days, then put to germinate without further treatment. Two lots, S-15 and S-24, gave satisfactory germination, the other 9 lots while generally low were somewhat higher than seed that had been soaked for 72 hours (treatment 4).

Treatment 8 represents the same treatment as No. 7, followed by chilling in petri-soil at 5°C for 6 weeks before germinating. The results from this treatment approximate or equal the highest results obtained from any other treatment except in No. S-24 which is somewhat lower.

Figure 1, B shows the per cent of caryopses germinating. The graph shows the same general response as the per cent of burs germinating and the results will not be taken up in detail here. Uniformly high results were obtained by soaking the seed 48 hours, then prechilling before germinating (treatment 7). Almost equally beneficial was prechilling in petri-soil without previous wetting (treatment 2).

Figure 2 shows germination results obtained from seed harvested at different stages of maturity. The dates of harvest, stage of maturity, and pretreatment of the seed are indicated in the figure. Two lots of seed were tested, only one of which is shown here. The material tested is insufficient to give conclusive results, but as both lots show the same general trend it seems worthy of consideration. Satisfactory results were obtained by either drying the seed at 40°C for 6 weeks before prechilling in petri-soil, or by soaking the seed in water for 48 hours, drying thoroughly at room temperature, then prechilling in petri-soil. Both bur and caryopsis germination of seed from the last date of harvest declined somewhat, suggesting a possible increase in dormancy as the seed becomes fully ripe.

The results of greenhouse tests were comparable to the corresponding tests made in the laboratory. In the room having the higher night-day temperatures (70-85° to 90°F) germination was quicker and averaged slightly higher, and the seedlings were markedly more vigorous than in the cooler room (60-75°F). The best results were obtained from seed that had been prechilled in petri-soil at 5°C for 6 weeks. In general, soaking the seed for 1 hour in either water or potassium nitrate, draining, and storing damp without substratum in 5°C for 6 weeks before planting gave lower and more variable results. However, not enough replications were made by this method for conclusive results.

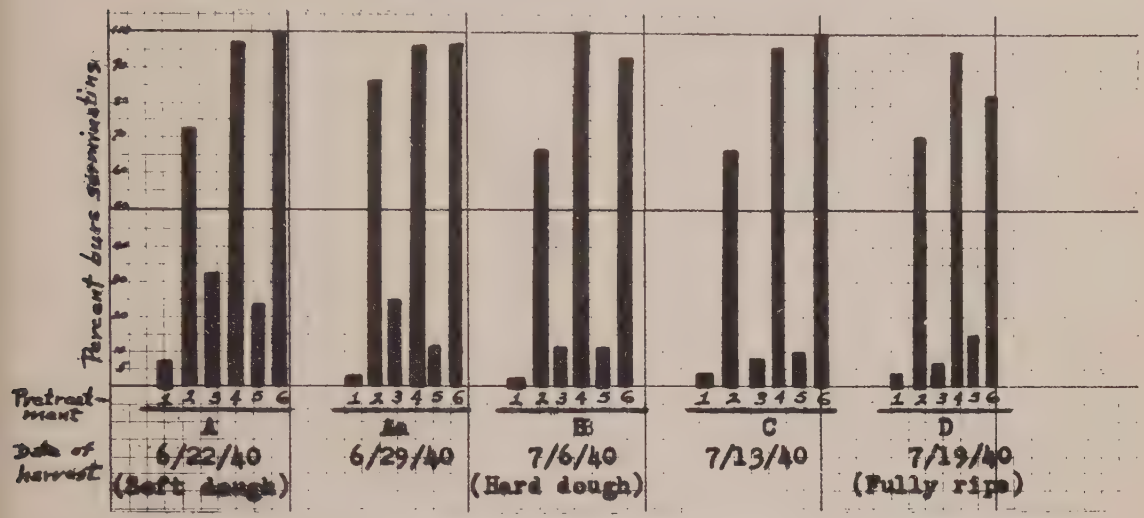
Incidental Observations

In sectioning the burs used in these tests it was observed that seed lots differ in size of bur and the number and character of the caryopses. In some lots the burs were exceptionally small, averaging about 2 florets per bur, others averaged 5-7 per bur. A completely filled bur was rarely found. In the lots examined the per cent of burs filled varied from 9 to 77, about half of the samples being between 50 and 65 per cent filled.

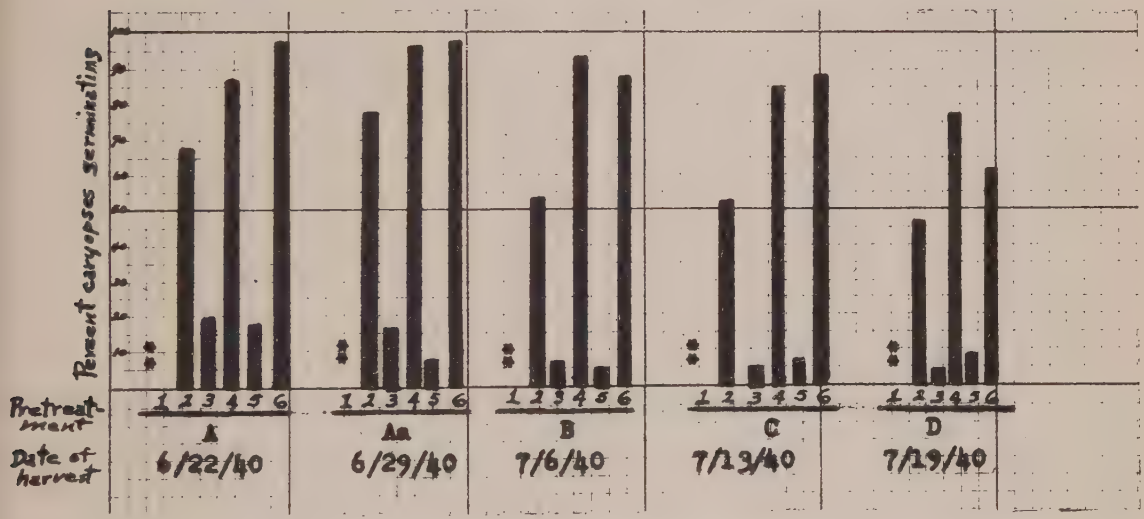
The presence of diseased caryopses in a bur did not appear to affect the germination of the sound caryopses.

The burs in some lots carried a high proportion of caryopses with poorly developed endosperm. The seedlings from such burs were weak and

FIGURE 2, - The effect of various pretreatments* on the germination response of seed harvested at different stages of maturity (Sample no. S-16)



A - Percent of burs germinating



B - Percent of caryopses germinating

*Pretreatment
1 - None
2 - Prechilled petri-soil, 5° C, 6 weeks
3 - Soaked in water 72 hours, dried at room temperature
4 - As in no. 3, followed by prechilling in petri-soil, 5° C, 6 weeks
5 - Stored in cloth bags, 40° C, 6 weeks
6 - As in no. 5, followed by prechilling in petri-soil, 5° C, 6 weeks

** Not calculated

frail and it is doubtful that they would become established under the less favorable field conditions. A few samples produced seedlings with vigorous plumules but with weak roots. These roots developed normal growth under the optimum temperature and moisture conditions of the germinating chamber but they probably would not survive in the field.

Since only well-filled burs producing vigorous seedlings can be expected to establish themselves under possible adverse conditions it is important that a seed lot be given a careful laboratory examination to determine its desirability for planting.

Summary and Conclusions

Seed, other than freshly harvested, will germinate about equally well after either of the following pretreatments; (1) prechilling in petri-soil at 5°C for 6 weeks, or (2) soaking seed in water 48 hours, drying thoroughly at room temperature, then prechilling at 5°C for 6 weeks. Many samples give maximum germination in 5 to 7 days with little or no increase thereafter, while less vigorous seed requires 14 to 21 days.

Preliminary tests made of seed at different stages of maturity suggest that freshly harvested seed is benefitted either by drying at 40°C for 6 weeks or by soaking for 48 hours in water, before chilling. The results of these tests suggest the possibility that dormancy increases as the seed becomes fully ripe. In the two lots tested the best results were obtained in both bur and caryopsis germination from seed harvested at the hard dough stage or a little earlier, in this case about the first of July.

Results of soil tests in the greenhouse were comparable to the corresponding chamber tests made in the laboratory. The best results were obtained from seed that had been prechilled in soil before planting.

These tests show that the planting of untreated seed would be generally unsatisfactory. The ease of handling the seed in the pretreatments used in this study suggests the possibility of adapting these methods for use on a larger scale for field planting.

THE PRODUCTION OF CLOVER SEED

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The information herewith presented is based upon data accumulated through a farm-to-farm study during the past two years on small seed production, especially red clover seed in this state.

Clover seed production in New York State is seldom attempted on a large scale but usually as a secondary feature. Weather conditions make it a venture of many uncertainties, therefore one which is not depended upon for a main source of income. Many farmers, however, raise enough seed to supply their own needs, and in favorable years, the excess is sold to neighbors or to dealers. The second crop is usually the only one from which seed is taken.

In visiting with farmers the merits of the combine as compared with the clover huller as it affects seed quality is a much discussed question.

It was found that in an average year in this area approximately 40% of all clover seed is harvested with a combine, the remaining 60% with a clover huller. It was found that either method may be used to good advantage if weather conditions permit. It was found that because the huller is used under more favorable conditions that its work was usually more satisfactory. This is because the seed is threshed either from a dry swath or after storage in a barn. When combining directly from the standing seed crop the damp immature heads mix with the mature ones and in this damp condition it becomes difficult to remove the seed from the hull. Red clover seed combined under such conditions requires immediate attention in the way of drying and recleaning to prevent heating. Many farmers who combine directly wait until the first good frost after which the heads all dry uniformly in the stand. Weather conditions are too uncertain in most instances to rely on this. Each year more of the small seed combining is done by the windrow combine method which has proven more satisfactory but involves more labor than the direct combine method. There is the question of seed loss by either method but it was found that the seed loss through waiting for full maturity about equals that lost in the handling required to cut and dry the clover. The largest loss in using a combine occurs when the plants are slightly green or damp, or the operator has not had the experience necessary to properly adjust the machine for all the varied conditions. An extra recleaning is necessary with combined seed since more weed seed and inert material are left with the pure seed. There also is more tendency to reject weedy patches in fields when the crop is cut with a mower since it is easier to cut around them with a mowing machine than with a combine. Much of the threshing done with the customary clover huller is custom work and is done by experienced operators. More farmers are operating their own combine each year for small seeds, thereby reducing labor costs. In some cases the operators lack experience and the combine necessarily does a poor job of threshing and cleaning mainly because the machine is improperly adjusted. The combine can when properly adjusted deliver a clean seed crop during a good seed year when the stand of red clover is thick, weeds few, heads matured evenly, and dry weather conditions prevail at the time of harvest.

As regards cleaning processes it was found that 62% of all red clover seed lots in this area are recleaned in a No. 2 Clipper cleaner; 27% by large commercial mills; and 11% by miscellaneous cleaners such as the Nc. 1 Clipper, Chathams, Winner, Vacaway, etc. It should be said that these small mills, through which the large bulk of the seed is recleaned, are inadequate to cope with the weed seed situation. The great need is for cooperative cleaning where the high cost of the intricate cleaning equipment is borne by a group or that all seed lots be sent to large cleaning mills now in operation.

When it comes to using the facilities of the seed laboratory it was found that 58% of all growers have their seed tested only when they propose to sell, 22% always have their seedstock tested whether they plan to sell or plant it themselves; 8% never ask for a test; and 12% sell direct to a dealer without tests. This would indicate that most seed growers are law abiding, yet are not greatly concerned about the weed seeds they are putting back on their own farm.

A study of the constructive criticisms regarding how best the seed testing laboratory can fit into the program was most interesting. As a whole the work of the seed laboratory was looked upon as a necessity and beneficial to all concerned. Of the complaints, as such, the one most often repeated was why must there be a fee charged a farmer for a test just because he would like to sell one or two bushels of seed? This probably

should be expected. In answer to these statements it was pointed out that the laboratory was authorized to test samples free only to those using the information for their own guidance in planting, but not free to those using the test for commercial purposes. The second most often repeated complaint was the failure of the seed laboratory to release information concerning the relative merits of the different seed sources, that is, a fair index of the reliable seedsmen. What farmers seem to need is an easily understood, ready reference list of thoroughly reliable seed dealers.

Two types of complaints were registered against dealers, namely, that through implications the dealer often induced the farmer to bear the expense of the tests made on seed the dealer intended to buy from him, and second, that of the sale of inferior seed stocks in many cases.

Of the weeds most feared by small seed growers Chicory was rated first with field bindweed second in importance. Curly dock, sow thistle, oldfield cinquefoil, and buckhorn plantain came in the order named.

The weed seeds in the order of their frequency in red clover seed lots were common ragweed, wild carrot, and green bristlegrass. In 1940 wild carrot and green bristlegrass were both more frequent than ragweed. It is believed that weather conditions during the past year greatly influenced their frequency.

The raising and harvesting of each kind of hayland crop seed is a profession in itself. Alfalfa, alsike, red, white and sweet clover each present different problems and require special study and care in their handling. Seed growers in each seed growing area and each year will find different and special difficulties with which to contend.

Based upon the experience and information gained by the writer in this farm-to-farm visitation it is suggested that those directly responsible for the output of the seed testing laboratory, its policy and its operation can gain much useful information by these direct contacts with growers, buyers and distributors of seedstocks.

LABORATORY GERMINATION OF BELLADONNA (ATROPA BELLADONNA) SEED[1]

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The propagation and cultivation of belladonna from seed has been practiced in the United States more or less for many years. However, the scarcity of seed has manifested itself at the present time due to the source of supply from foreign countries being cut off because of the international situation. This demand for seed stock to supply the greater plant production in this country has increased the interest in viability of the belladonna seed that is available. Several lots of seed were received at the Geneva laboratory during the past year for testing. Poor, slow and irregular germination occurred in all lots when the seed was subjected to the usual methods employed in routine laboratory practice. It was noted that many firm and healthy seeds did not germinate readily, thus indicating various degrees of formancy in most seed stocks.

According to the German rules for seed testing (3)[2] a temperature of 20-30°C and a germination period of 28 days is recommended either in the

[1] Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 456.

[2] Numbers in parentheses refer to literature cited.

light or in the dark. However, none of the lots tested by the writer responded sufficiently to those conditions to give an accurate viability percentage.

Both Sievers (2) and Schneider (1) have reported irregular and prolonged field and greenhouse germination of belladonna seed unless it was given special treatment.

Sievers (2) found that seed sown in the fall germinated quickly while spring-sown seed germinated slower and often irregularly. This information and the writer's observations on preliminary tests in the laboratory indicated that the factors of temperature, potassium nitrate solution, prechilling of the seed prior to germination and the substratum during termination, might have material effects on the breaking of this dormancy.

After various preliminary tests had been made one lot of belladonna seed was received which showed 95% germinative capacity. This lot was subjected to various treatments to overcome its seed dormancy. A series of tests were set up at various temperatures in germination chambers, the seed being placed on the top of moist blotters. The results of germination at the various temperatures are presented in Table 1.

TABLE 1. - The Effect of Temperature on the Laboratory Germination of Belladonna Seed

*Condition & Temperature	Germination in days			
	10 %	20 %	40 %	60 %
Daylight 20-30°C	-	8	27	35
Dark 20-30°C	2	12	16	21
Daylight 15-30°C	-	5	58	71
Daylight 25°C	-	-	1	3
Dark 20°C	-	-	-	-
Daylight 15°C	-	-	-	-
Dark 15°C	-	-	-	-

*Dark refers to a closed germination chamber but the seed was subjected to some light rays when the doors were opened at various times.

Daylight refers to a germination chamber with a glass back which admits normal daylight at all times.

It can be readily seen that either low or constant temperatures were not inducive to germination while a 15-30°C alternating temperature, the most extreme attempted, appeared to be most favorable. However, as this lot appeared more dormant than some of the previous ones and as many good seed remained after a 60-day period, more extreme treatments were tried with various conditions being altered. The effect of moistening the substratum with a .2% solution of KNO_3 at various alternating temperatures was studied along with a moist prechilling seed treatment for 25 days at a temperature of 3-5°C prior to germination. The results of these treatments are shown in Table 2.

All of these seed were germinated in open petri dishes (except those at room temperature) on filter paper over cotton saturated with distilled water or potassium nitrate solution. These were placed in a daylight germinator at the temperatures specified in the table. The first figure in all cases of the alternating temperatures as specified in both Tables 1 and 2 (for example 20°C) was held for approximately 18 hours while the second figure (30°C) was held for the remaining 6 hours of each 24-hour period.

TABLE 2. - The Effect of Potassium Nitrate and Prechilling on Breaking Dormancy in Belladonna Seed

Treatment and germinative condition	Germination in days			
	10 %	20 %	30 %%	40 %
H_2O --Daylight 20-30°C	5	32	51	56
KNO_3--Daylight 20-30°C	38	88	92	94
H_2O --Daylight 15-30°C	2	46	70	73
KNO_3--Daylight 15-30°C	22	85	91	92
H_2O --Daylight 35-15°C	12	77	84	84
KNO_3--Daylight 35-15°C	22	88	90	90
H_2O --Artificial light Room temperature	-	-	-	-
KNO_3--Artificial light Room temperature	10	43	51	57
Prechilled for 25 days at 3-5°C				
H_2O --Daylight 15-30°C	70	89	91	91
KNO_3--Daylight 15-30°C	82	86	86	86

It is interesting to note that, as in Table 1, where water was used to moisten the substratum the most extreme alternating temperature, namely, 35-15°C proved most beneficial. Also by comparing these results with the former figures under similar conditions on top of blotters it appears that a substratum of filter paper and cotton is preferable to a blotter. The marked benefits from potassium nitrate treatment at all temperatures can readily be seen except in the case of prechilled seed where the prechilling treatment thoroughly breaks any existing dormancy. The cause for lack of germination under artificial light (25-watt bulb) where the substratum was moistened with water cannot be positively explained, except the writer believes that the lack of extreme alternating temperatures may have inhibited germination. The room temperature varied from 18° to 28°C but the change was very gradual as compared with the more or less rapid shift which occurred in the germinators due to accurate artificial controls. Another point which might have had an influence on this germination reduction was the fact that closed petri dishes were used at room temperature instead of the open ones, thus possibly altering either the moisture or aeration factors. Whether shorter prechilling periods than 25 days would be effective in breaking the dormancy cannot be stated.

Summary

1. Belladonna seed stocks exhibit various degrees of seed dormancy.

2. In order to discover the most satisfactory method of laboratory germination in the shortest time the factors of temperature, light, potassium nitrate treatment, prechilling and substratum were studied.

3. Best results were obtained with filter paper on cotton as a substratum which was moistened with a .2% solution of potassium nitrate.

4. Extreme alternating temperatures appeared to be most desirable especially when the seed was germinated on top of blotters or when the substratum was not moistened with KNO_3. However, with KNO_3 treatment either 20-30°, 15-30°, or 35-15°C gave an accurate viability percent in 20 to 30 days.

6. Prechilling the seed for 25 days at 3-5°C produced rapid and uniform germination, the test being complete after 15-20 days. These prechilled seed did not need KNO_3 treatment.

7. For maximum field germination these tests indicate that the seed should be either sown in the fall or spring-sown seed should be prechilled before sowing.

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APPROXIMATE GERMINATION TESTS OF DORMANT SEEDS BY EXCISING EMBRYOS[1]

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Seed analysts are presented with a problem of overcoming extreme dormancy in many seeds, since they will not germinate under the usual laboratory methods employed for cereal and garden seeds. This group includes many tree and shrub seed and a few flower and various rock garden plant seed. There is now no official seed testing method for these dormant seed and the question arises as to how one is to determine the viability of such seed for the seed dealer or the planting value of these seed for the nurseryman.

The degree of dormancy varies considerably with the species and often may vary within the species or even within a seedstock due to factors of collection and storage. Before these seeds can be tested they must be subjected to long periods of afterripening (1-6 months) at a low temperature, usually 3-5°C for best results, and thentransferred to normal germination temperatures. The writers prefer the normal germination test procedure as the best method of testing viability and even where seeds may require 15-30 days moist prechilling to break dormancy the preference would still be in favor of the standard germination test. However, the approximate germination of those seed which require more than one month of prechilling to break dormancy may be determined by observing the growth and development of their excised embryos. The time involved for normal germination tests of these extreme dormant seed is too long to secure a viability per cent that would be of any value to the interested party.

Various workers (1),[2] and (4) have suggested excising embryos for determining the viability of various seed and have reported a fairly close correlation between their results by this method and those obtained by normal germination of afterripened seed. In the past, cutting tests have been used by nurserymen and seed dealers to determine the per cent of good seed in hardwoods and shrubs. The senior author (3) has shown the fallacy of this method with cucumber tree wherein two lots which gave 98 and 100% good seed by cutting the seed open gave 0 and 85% field germination, respectively. Viability tests on the same lots showed 0 and 90% good seed within a few

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[1] Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 457.

[2] Number in parenthesis refers to literature cited.

days. Thus much time, labor and expense can be eliminated when these viability tests indicate that seed stocks are worthless or dead.

The writer has used this excising method with success to determine viability of certain tree seed since 1935. The approximate germination of many types of seed have been secured at the Geneva laboratory during the past year by the excising method. Observations have been made on the growth and behavior of these embryos for various species, the details of which will be published later. Among the tree species the peach, (Prunus persica), plum (Prunus domestica), ash (Fraxinus sp.), sweet gum (Liquidambar styraciflua) and hawthornes (Crataegus sp.) have all been given special consideration and the embryos of all have responded very well when placed in petri dishes on moist filter paper and cotton. The embryos of many shrub seed have been removed and studied, the ones receiving the most attention being bittersweet, (Celastrus scandens), Japanese barberry (Berberis thunbergii), Japanese flowering quince (Cydonia Japonica), Bignonia, and witch-hazel (Hamamelis virginiana). Other species which did not give proper response by a germination test without prechilling but which did respond very well by excising the embryos were Martynia, and Snow-on-the-mountain (Euphorbia marginata).

The best technique for removing the embryos must vary according to the type of seed. The embryos of many species may be removed readily after soaking the seed over night or a few days depending on how long it requires the seed to absorb water and become plump. Then the seed coats may be removed easily and a slit made with a sharp scalpel to release the embryo. Flemion (2) has described various techniques in excising embryos.

Most of the embryo studies by the senior author were carried on in petri dishes using moist filter paper and cotton as a substratum. Many of these were left at room temperature or 20-30°C alternation. Also, some embryos responded well on blotting paper in the daylight germinator. In general the best results were secured in closed petri dishes at room temperature.

There seemed to be less contamination from fungi and a better-controlled moisture in petri dishes as compared to germination chambers especially for the smaller embryos. Disinfectants were tried in a few cases but it did not seem necessary to take this precaution when care was taken in removing these embryos. Also, weak solutions of chemicals often injured the embryos.

These naked embryos react quite differently when placed in such artificial environment. Some species like Martynia, sweet gum, peach, plum, and others actually germinated at once and produced normal seedlings within a few days. Others like bittersweet, ash, snow-on-the-mountain and crataegus germinated gradually or showed slight activity and greening of the cotyledons. Other embryos remained perfectly white in color but enlarged somewhat and showed life either by spreading of the cotyledons or elongation of the radicle. Any of these characteristics indicate life and seed exhibiting such characters can be counted as healthy seed, capable of germination with the proper treatment of after-ripening. Even the embryos of the most extreme dormant seed showed some activity under the described conditions. All dead and worthless seeds will turn brown or deteriorate rapidly and can be counted as such. Since only the embryos are used by this method in securing viability, the final percentage for any seed stock must be corrected since empty, visibly bad, or insect-infested seed were discarded in the process of excising embryos.

The length of time required to secure an approximate germination by the excising method varied somewhat. Five to twenty days were required for the species studied while 10-14 days can be considered a good average.

Several factors influenced the growth and activity of excised embryos. Temperatures around 25°C gave more prompt germination in those species where actual germination occurred but this increased activity was not noted in lots where embryos did not germinate. A room temperature of 20-24°C was very satisfactory for all species. Excessive moisture was inhibitive to the best embryo development and occasionally caused decay when the substratum was too moist.

Soaking the seed prior to excising usually produced more activity in the embryos. Euphorbia embryos removed from seed that had been soaked 10 days at room temperature germinated higher and showed more greening than those embryos from seed which had been soaked only a day or two. A 0.2% solution of potassium nitrate used for moistening the substratum had a marked effect on most species. Euphorbia, bittersweet, and white ash especially gave higher actual germination at the end of 15 days when KNO_3 was used. It not only gave higher germination in all cases but also produced more greening of the cotyledons and more activity in general. The embryos reacted quicker with KNO_3 and a larger percentage of them showed greening. The disadvantage of using potassium nitrate was increased fungus growth in cases where it became established. The use of potassium nitrate is not essential or recommended because the probable germinability of all embryos can be detected without its presence.

Summary

Experiments with many types of dormant seed including tree, shrub and flower seed have shown that the viability of such seeds can be determined in 5-20 days by observing the activity of excised embryos when placed in moist conditions of daylight at a normal germinating temperature. The good seed will either germinate, show greening or spreading of the cotyledons or increased swelling and development while the nonviable seed will soon discolor or decay. Thus the approximate percentage of germination can be obtained on any dormant seed within a short period of time so as to be of practical value to both the seed analyst, seed dealer or planter of such seed. Results obtained by excising embryos appear to agree very well with actual germination tests of afterripened seed which may require 2-6 months for completion. It is suggested that this method be given consideration by the Association in handling such types of extreme dormant seed.

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NEW ZEALAND SPINACH GERMINATION STUDIES[1]

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The difficulty of obtaining a satisfactory laboratory germination from New Zealand Spinach seed (Tetragonia expansa) is a problem of long standing with seed analysts. Laboratory germination is very likely to be erratic and wide variations occur in the response and behavior of various seed lots, although the seed analyst may employ identical methods of germination. Also, wide variations in germination figures are very often the case in the same seedstock when the seed is subjected to different environments or even when the seed is germinated at different times under supposedly similar conditions. These variations and discrepancies were noted in check tests on certain samples by the writers and Bass (1)[2] has reported it in duplicate tests on the same seedstocks.

The character of the seed and fruit of New Zealand spinach has been described by Bass (1). The fruits are hard and nut-like and each fruit contains several seeds one or many of which may germinate from a single fruit. These fruits vary in size, color and shape and are covered with a more-or-less spongy pulp which often varies in thickness around the nutlike structure. This spongy material absorbs water readily and holds it very well once the fruit has become saturated. Each seed cell is covered with a more-or-less hard cap and in certain cases may be impermeable as reported by Bass. However, the writers are of the opinion at the present time that the water-holding and -retaining capacity of this spongy material and its relation to germination is much more important than the mechanical breaking of these caps which cover the seed.

Several methods of germination have been tried and suggested in the past. The temperature and substratum has been varied, soaking in water at various times and temperatures have been tried, as well as both chemical and mechanical treatment. The method suggested by Bass (1) consisted of a soaking at 45°C and then running the test for 10 days, counting germination, and drying the seed for 48 hours before replacing the seed in the germinator. This procedure is repeated as often as necessary which usually requires 3 dryings and takes about 6 weeks to complete a test. Patterson and Forward (2) found that the clipping method was more successful than several other methods which included the alternating drying method. Pipe and Hope (3) germinated seed under several conditions with various pretreatments and found that alternating temperatures of 20-30°C for 16 hours and 18-20°C for 8 hours where the seed was placed between blotters gave highest results.

The writers began their studies with the idea of attempting to discover the factor or factors which affect the germination of New Zealand spinach seed and also to endeavor to correlate these factors in order to explain why most workers have developed different methods all of which appear to be successful at certain times.

Is it a matter of technique, variation in seedstocks or is it a matter of controlling certain factors during germination by definite knowledge and personal judgement? The source of the seedstocks used in the present studies was not known so this factor is uncontrolled and this fact should be remembered when conclusions are drawn from the secured results.

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[1] Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 458.

[2] Numbers in parentheses refer to literature cited.

In other words we believe that analysts in attempting to solve such a problem must work with the plant in the field, study the seed formation and have full knowledge of variations in seed stocks due to growth, maturity, collection and methods of handling. We propose to do this in the future and all the conclusions presented here may be considered preliminary.

Explanation of Methods

The following methods of technique were attempted at the beginning of the studies. These are listed and given a number which alone will be referred to hereinafter both in the text and tables.

No. 1 - Seed cracked slightly while dry with a hammer so as to loosen the partitions of the nut-like fruit. Care must be exercised so as not to crush the seeds. This procedure was attempted with the idea of allowing water to enter readily and also to loosen the caps which enclose the seed.

No. 2 - Seed given no pretreatment of any kind (check method).

No. 3 - Seed soaked in water at room temperature usually over night and then scraped with a sharp knife or rubbed on a screen to remove the spongy pulp on the apex side of the fruit where the sprouts emerge. Oftentimes a few of the hard caps were broken or removed in this process. Care must be taken in this procedure also or the embryo tips may be injured and decay readily in germination. (This is similar to the clipping method.)

No. 4 - Seed soaked in water at room temperature usually over night (approximately 16-18 hours). This is more or less a check on method #3 and #5.

No. 5 - Seed soaked as in #4 and then cracked in a moist condition with a hammer as in #1. This method will not be given much consideration in the text because it did not prove satisfactory after a few preliminary tests.

A daily alternation of temperature, namely 20°C for 16-18 hours and 30°C for 6-8 hours was used in all of these reported experiments. This temperature is recommended by the Association (4). A temperature of 15-30°C was used in a few tests but gave slower germination. The seed requires high temperatures for satisfactory germination.

Seed was germinated between towels and between blotters for each of the methods described above. Five to eight lots were used with each method and all the conditions were kept the same so that the only variation within a method was the substratum itself. The results of the individual lots are not given but the averages by methods are presented in Table 1.

TABLE 1.- Comparison of Results of Germination between Folded Towels and Blotters. (Average figures given and based on 5-8 lots respectively.)

Method	Total germination by days					
	Between towels			Between blotters		
	Days 7 %	15 %	30 %	7 %	15 %	30 %
No. 1	23	28	29	22	29	31
No. 2	14	22	23	10	17	21
No. 4	5	8	11	7	10	14
No. 5	10	14	14	11	14	14

It can be readily seen that there was no difference between the results obtained in favor of either the towels or blotters. Consequently

hereafter all tests were run between blotters unless otherwise stated.

Comparison of Methods

In order to check on the methods adopted by the writers all service samples were subjected to these various methods as they came to the laboratory for routine testing. All seed was placed between blotters and held at 20-30°C alternation. When enough seed was present in the samples, check tests were often run in "virgin" muck soil or peat moss and various "side-line" experiments were carried on. These will be mentioned later in the text.

TABLE 2.- Results of Germination by Four Different Methods of Seed Treatment

Sample No.	Method #1			Method #2			Method #3			Method #4		
	Days 7 %	15 %	30 %	7 %	15 %	30 %	7 %	15 %	30 %	7 %	15 %	30 %
1	31	34	34	20	22	24	56	58	68	11	12	13
2	2	2	3	4	4	6	12	15	15	0	2	4
3	10	22	24	8	10	10	32	34	42	8	14	21
4	12	18	18	8	12	18	60	62	65	6	11	18
5	45	51	52	15	31	36	52	66	88	14	22	26
6	25	32	32	12	22	23	34	39	40	0	4	4
7	19	30	31	0	4	6	22	35	39	12	16	24
8	21	30	33	6	10	10	48	48	48	8	20	20
9	25	41	42	12	21	24	22	26	26	19	25	25
10	12	13	15	8	16	24	19	22	29	2	4	11
11	30	48	54	20	42	46	58	74	74	16	44	60
12	42	44	44	24	48	64	80	90	90	22	42	48
13	50	66	66	24	40	48	42	66	66	24	40	46
14	34	46	52	18	36	50	56	54	64	18	30	42
15	2	10	12	0	7	10	14	26	30	1	7	9
16	22	22	30	8	10	28	74	76	78	30	39	49
Average	24	32	35	12	21	27	43	50	54	12	21	25

The most striking feature of these figures is the rapid and high germination secured by the No. 3 method or the socalled "scraping" method. Even at the end of the 7-day count some lots had nearly completed their germination. The hammer-cracking method accelerated germination in some cases but the results in general were not significant enough to warrant its continuance or recommendation in general practice. The soaking alone compared very closely with the dry check lots but the good feature in the soaked method was the elimination of certain fungus growth on the seed especially in the poorer stocks. One might ask from these results "why not follow method No. 3 and recommend it for general use?"

Moisture Relation to Germination

This question brings up the factor of moisture and its relation to seed germination. Among the socalled "side-line" experiments seed was germinated under different moisture conditions on moist cotton in petri dishes, peat moss and muck soil and in all cases the drier conditions gave best results. Even the No. 3 method was very sensitive to wet conditions during germination. At the end of 15 days, when germination is very often nearly complete by this method, variations were recorded as follows:

Wet	Normal	Dry
15%	39%	51%

The socalled normal condition was that used which anyone would consider optimum. In other words it appears that the substratum should be kept drier than one might suspect especially where the seed has had a previous soaking. What does the "dry pack" method as used by Bass and Patterson accomplish? What does the scraping method accomplish as presented by the writers? What does the placing of soaked seed under fairly dry conditions for germination either in blotters, peat, or muck soil accomplish?

The writers believe that all these perform the same function, that is, removing the excess or possibly free moisture which is held by this spongy material and which inhibits germination. An average increase in germination of 23% was secured by the writers when 8 lots were taken from the germinator after a 30-day period and dried in the room for 2 days before replacing them in the germinator. The same lots showed an increase of only 2% germination in the checks that remained undisturbed. By scraping the pulp around these seed, water could be forced out even though the blotters themselves did not appear too moist. Most of the variations which occurred in peat moss or muck soil also could be attributed to a moisture relation. Some of the occasional lots tested in muck or peat gave better germination than by scraping.

Consequently, in order to further check and see if other practices would give as high results as method No. 3, 10 samples were soaked over night and germinated on top of muck soil besides the regular methods #3 and #4 between blotters. The muck was friable and appeared slightly moist when pressed in the hand.

TABLE 3.- Comparison of Results with Soaked Seed Germinated under the Different Conditions. (Figures given in total germination on the specified days).

Lot	Method #3			Method #4			#4 Top Muck		
Days	7 %	15 %	30 %	7 %	15 %	30 %	7 %	15 %	30 %
A	0	8	10	0	0	8	0	27	40
B	24	34	40	5	14	15	2	26	41
C	40	48	54	14	26	34	0	30	46
D	46	58	62	12	20	24	4	50	56
E	76	82	84	22	34	50	6	58	67
F	60	64	68	13	18	25	11	47	72
G	60	76	76	36	48	58	0	48	50
H	60	64	68	12	36	46	0	38	48
I	52	78	80	16	46	50	0	70	88
J	28	36	36	20	26	30	36	56	58
Average	45	55	58	15	27	35	6	45	57

These results seem to indicate that successful germination can be secured on top of muck soil that is not too wet and the average total germination after 30 days checks very well with that obtained by the scraping method. Why do the tests between blotters run so much lower than the other methods? If it is a moisture relation can it also be controlled?

Subsequent tests between blotters which were moistened normally and held nearly dry seem to indicate that nearly the same high results can be obtained between blotters as by any other method if the proper moisture

relation is maintained. At present the studies are being continued and close checks are being held on the moisture factor. Moisture content of the muck soil and peat moss is being determined and some measure of the moisture content of blotters will be determined with the idea of developing a standard procedure which may be followed by all.

Soil and Peat Moss Germination Studies

Studies with muck soil and peat moss have indicated that tests may be run easier and the counts can be recorded sooner if the seed is placed on top of the media rather than covered at various depths. The ideal method is to scatter the seed on the top of peat or muck and then firm the seed into it by means of a flat board or "tamper." Thus all seed are in direct contact with the media and the excess water in the spongy pulp is withdrawn from the fruit if the media is only slightly moist to the feel of the hand. In these experiments all peat and muck used was passed through a $\frac{1}{4}$-inch mesh screen and this should be adhered to for similar results. Present tests being run on top of peat moss and muck soil seem to indicate that either is suitable if ideal moisture conditions exist. However, as the peat moss is a more standardized medium throughout the country than either muck or other soil, the authors prefer it as being slightly more promising. It is also lighter in weight and cleaner to handle. Peat or muck if firmed as suggested when placed in the germination chamber will need no more watering or sprinkling during the whole course of germination. In closed germination chambers, as used in these experiments, the ideal moisture relation was maintained once it had been established.

Frost Action on Seed

In order to determine the effect of frost action on the socalled hard caps around the embryos, several lots were frozen for various lengths of time and then germinated between blotters and on top of muck along with the original seed. No stimulating effects were secured by freezing the seed. The results on top of muck were nearly identical while the frozen seed did not do as well between blotters as the original seed, but here again it may be a moisture relation.

Summary

1. Special studies were attempted to analyze the factors which cause wide variations in germination of New Zealand spinach seed stocks, and to endeavor to overcome the difficulty involved in securing a satisfactory laboratory germination.

2. The importance of the spongy pulp which surrounds the seed and its ability to absorb and retain excess moisture cannot be over estimated. Its relation to germination is considered significant.

3. Alternating temperatures of 20°C for 16-18 hours and 30°C for the remaining 6-8 hours of a daily period appeared to be satisfactory. Cooler temperatures gave slower response.

4. Germination was the same between folded towels or between blotters so long as the moisture conditions remained the same.

5. Cracking the seed while in a dry condition with a hammer accelerated germination in some cases but the results in general were not significant enough to warrant its recommendation.

6. Scraping the fleshy material from soaked seed with a knife or by rubbing it on a screen produced the most rapid and often the highest germination. After 7 days some lots had nearly completed their germination.

Both a mechanical action and moisture relation may be involved in this scraping method.

7. Soaking the seed overnight did not increase germination significantly over that of dry seed but it did eliminate some molds and all seed stocks are saturated thus giving a uniform condition to all seed. By placing these soaked seed in a substratum which will take up the excess moisture fairly rapidly successful germination may be expected.

8. The relation of moisture to germination is very important no matter what method or technique is employed. Germination was inhibited by excess moisture even after the seed had been scraped. Studies are being continued on this moisture relation to germination in blotters, soil and muck. At present we can state that any substratum should be kept drier than one would consider an optimum condition.

9. Successful germination was secured on top of muck soil or peat moss by simply pressing the seed into the medium with a flat board or "tamper." This may be the ideal medium to remove the excess moisture from the spongy material. No surface watering should be done after the seed is firmed into the medium.

10. Freezing the seed for various lengths of time did not increase germination.

11. The factor of seed source and how much it might affect the germination was not taken into consideration because the history of the samples used in these experiments was unknown. The writers wish to point out the importance of the knowledge of seed source before a problem of this type can definitely be solved. The studies will be continued with that in mind.

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EFFECT OF LOW TEMPERATURES ON THE GERMINATION OF SORGHUM AND SOYBEAN SEEDS (Abstract)

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Seeds of 9 varieties of sorghum and 8 varieties of soybeans were collected from the field in 1940 at different dates beginning in early September. The moisture content and viability of the seeds at each time of collection were determined before and after exposure to low temperatures. A summary of the results is as follows:

1. Sorghum seeds were germinable when their moisture content was between 50 and 60%. Soybean seeds with a moisture content of 70% were germinable.

2. Freshly harvested, immature seeds of sorghum were dormant. Dormancy was overcome by curing, by prechilling, and by continuing the test at 20-30°C until all viable seeds had germinated. Immature seeds of Peking soybeans from one collection were dormant and required 41 days for all of the viable ones to germinate at 30°C.

3. The viability of immature sorghum seeds was affected by the method of curing the seeds. Seeds allowed to cure by hanging the panicles in the laboratory germinated better than those which were threshed and cured in cloth sacks.

4. Mature sorghum seeds with a moisture content of 15% or less were unaffected in viability by exposure to any temperature between 33° and -22°F.

5. Immature seeds of sorghum and soybeans were reduced in viability by exposure to low temperatures. The reduction in vitality at a certain moisture content increased as the temperature decreased. As the moisture content decreased the reduction in viability from exposure to any certain temperature decreased also.

6. Sorghum seeds in small lots with a moisture content of 16 to 19% were not seriously injured by exposure for ten hours to a temperature of -20°F. Exposure for ten hours at -20°F caused serious injury when the moisture content of the seeds was 22% or more.

7. Soybean seeds in small lots with a moisture content of 30 to 32% or less were not reduced in viability by freezing for ten hours at -20°F. Soybean seeds may contain a much higher percentage of moisture than sorghum seeds without being injured by exposure to freezing temperatures.

8. Where immature sorghum is harvested for seed purposes high viability may be maintained by curing the seeds in the panicles.

9. The data obtained provide no information as to how large a quantity of immature seeds of sorghum and soybeans may be stored safely when subjected to low temperatures.

GERMINATION OF FRESHLY HARVESTED SEED OF KENTUCKY BLUEGRASS

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Because reports from some seedsmen and some laboratories stated that freshly harvested seed of Kentucky bluegrass, Poa pratensis L., did not germinate well soon after harvesting and that not until September or October were they able to obtain satisfactory germination, a series of germination tests with freshly harvested seed of Kentucky bluegrass of the 1940 crop was undertaken at the Seed Laboratory of the Agricultural Marketing Service.

The method given in the rules and regulations under the Federal Seed Act (act of August 9, 1939) for the germination of Kentucky bluegrass is to sow the seed on filter paper moistened with water in petri dishes placed for a period of 28 days in a dark chamber at 20°C for 18 hours, and in a daylight chamber at 30°C for 6 hours each day.

Twelve stripped samples and 8 threshed and cleaned samples were used in these tests. Replicates of the samples of seed were sown July 1, July 15, August 1, August 15, September 1, and October 1, 1940. The threshed samples were not obtained until late in July so the first test using commercial samples was August 1, 1940. As only commercial or threshed and cleaned samples are of interest to analysts only these samples will be discussed in this paper. Duplicate samples of 200 seeds each were sown, in petri dishes, on filter paper moistened with water and with N/100 potassium nitrate solution, and on soil moistened with water, at four different alternating temperatures: 15° and 30°C, 10° and 30°C, 12° and 30°C, and 20° and 30°C. The seeds were placed for a period of 28 days in a dark chamber at the lower temperature for 18 hours and in a daylight chamber at the higher

temperature for 6 hours each day except in the third set of alternating temperatures in which the seeds were placed at the lower temperature (12°) for 20 hours and at the higher temperature (30°) for 4 hours each day.

TABLE 1. - The Effect of Different Temperatures on the Germination of Freshly Harvested Seed of Poa pratensis L.

Sample No.	Percentage of germination at indicated temperatures (°C) on specified substrata					
	15°C dark and 30°C daylight			20°C dark and 30°C daylight		
	H_2O	KNO_3	Soil	H_2O	KNO_3	Soil
	August 1, 1940					
601322	83	80	82	79	78	82
6162	86	82	84	72	76	77
6163	86	83	88	81	83	88
6164	88	81	80	85	79	82
6167	81	79	82	79	84	71
6168	83	80	73	73	76	76
6169	82	85	82	78	84	90
Average	84	81	81	78	80	81
	August 15, 1940					
601322	80	85	81	72	80	78
6162	78	86	80	75	87	82
6163	83	87	82	81	84	84
6164	79	83	89	75	84	84
6167	84	79	80	80	80	78
6168	81	82	82	76	80	76
6169	84	84	83	74	80	84
Average	81	84	82	76	82	81
	September 1, 1940					
601322	84	90	87	79	88	84
6162	79	82	84	78	84	84
6163	89	87	88	83	86	82
6164	85	90	88	83	90	82
6167	87	82	80	81	80	82
6168	82	82	81	72	88	76
6169	84	88	80	79	87	73
Average	84	86	84	79	86	80
	October 1, 1940					
601322	86	89	78	86	90	88
6162	81	86	83	81	85	82
6163	86	90	84	83	85	89
6164	87	89	85	85	87	81
6167	77	84	81	80	82	78
6168	82	77	79	76	79	70
6169	86	80	86	83	86	78
Average	84	85	82	82	85	81

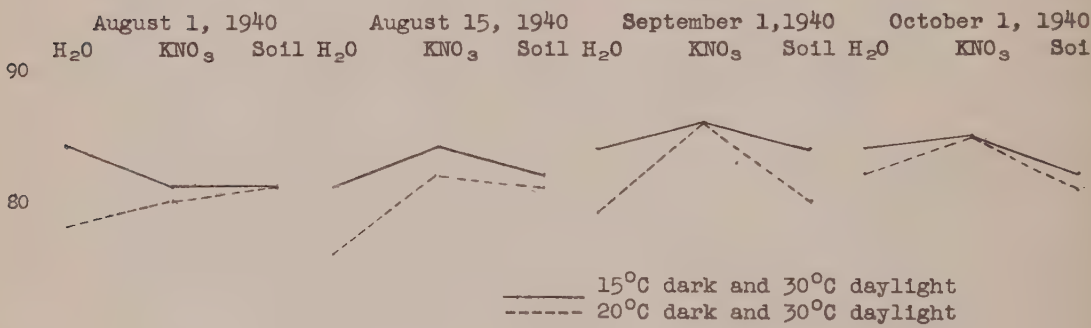
Approximately the same percentage of germination was obtained at 15° and 30°C, 10°and 30°C, and 12° and 30°C alternating temperatures on similar substrata; therefore for clarity the germination obtained at 15°and

30°C only will be compared with the germination obtained at 20° and 30°C alternating temperatures in this paper.

Seeds sown in petri dishes on filter paper moistened with water or with dilute potassium nitrate solution or on soil moistened with water at 15° and 30°C alternating temperatures gave approximately the same percentage of germination (about 83%) when sown August 1, August 15, September 1, and October 1, 1940.

Seed sown in Petri dishes on filter paper moistened with water at 20° and 30°C alternating temperatures gave about 5% lower germination (78%) when sown August 1, August 15, and September 1, 1940, than when sown October 1, 1940. Seed sown on filter paper moistened with N/100 potassium nitrate solution or on soil moistened with water, and also germinated at 20° and 30°C alternating temperatures, gave approximately the same percentage of germination when sown August 1, August 15, September 1, and October 1, 1940, and approximately the same percentage of germination as the seed sown in petri dishes on filter paper moistened with water, or with N/100 potassium nitrate solution, or on soil moistened with water, at 15° and 30°C alternating temperatures.

Graph 1. - Percentage of germination of 7 commercial samples of freshly harvested seed of Poa pratensis L. at 15°C dark and 30°C daylight and 20°C dark and 30°C daylight alternating temperatures.



Germination as a whole was slightly lower (about 2%) on the August 1 and August 15, 1940, sowings than on the September 1 and October 1, 1940, sowings. Germination with seed sown on filter paper moistened with dilute potassium nitrate solution was practically completed 21 days after sowing on all sowings at optimum temperatures, while seed sown on filter paper or on soil moistened with water was practically completed 21 days after sowing at optimum temperatures on some of the sowings.

From the above results it appears that a satisfactory germination of freshly harvested seed of Kentucky bluegrass can be obtained by sowing the seed in petri dishes on filter paper moistened with N/100 potassium nitrate solution or with water at 15° and 30°C (with the addition of light at the high temperature), alternating temperatures.

THE EFFECT OF DIFFERENT TEMPERATURES ON THE GERMINATION OF FRESHLY HARVESTED AND MATURE SEED OF AXONOPUS COMPRESSUS

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The fact that a number of laboratories reported that they were obtaining low percentages of germination with freshly harvested seed of carpet grass, Axonopus compressus, led the Seed Laboratory, of the Agricultural Marketing Service, to perform germination tests with freshly harvested and mature seed at several different alternating temperatures.

The method recommended in "Rules and Regulations under the Federal Seed Act" (act of August 9, 1939) is to sow the seed on filter paper moistened with water in petri dishes placed daily for a period of 21 days in a dark chamber at 20°C for 18 hours and in a daylight chamber at 35°C for 6 hours.

Two series of germination tests were performed. The first series was performed with 17 samples of freshly harvested seed[1] sown September 23, 1940. The second series was performed with seed from the same samples, which when sown March 14, 1941, were mature.

Duplicate samples of 100 seeds each were sown in both series on filter paper moistened with water and with N/50 potassium nitrate solution in petri dishes, placed daily for a period of 21 days at 3 different alternating temperatures; (1) room temperature (with a part of the time in daylight) and 35°C dark; (2) 15°C dark and 35°C daylight; (3) 20°C dark and 35°C daylight. The seed was placed at the low temperature for 18 hours and at the high temperature for 6 hours each day.

In the first series, in which the seed was freshly harvested and sown September 23, 1940, approximately the same percentage of germination (about 85%) was obtained when the seed was sown on filter paper moistened with N/50 potassium nitrate solution at all three alternating temperatures. When the seed was sown on filter paper moistened with water a lower percentage of germination was obtained at 20°C dark and 35°C daylight alternating temperatures (about 79% germination) than at room temperature (with a part of the time in daylight) and 35°C dark, and 15°C dark, and 35°C daylight alternating temperatures (about 85%).

In the second series, in which seed from the same samples were mature when sown on March 14, 1941, approximately the same percentage of germination was obtained with seed sown on filter paper moistened with water and with dilute potassium nitrate solution at all three alternating temperatures.

In addition to averaging the percentages of germination (Table 1, Graph 1) an analysis of variance was computed. For clarification and greater accuracy in obtaining the error for determining the F value an analysis of variance was computed for each substratum.

When the seed was sown on substrata moistened with dilute potassium nitrate solution there was a significant difference although no practical difference in the germination obtained on the two dates of sowing. There was no significant difference in germination at the three different alternating temperatures on either date of sowing.

When the seed was sown on substrata moistened with water there was a highly significant difference in germination on the two dates of sowing.

[1] The samples of seed of Axonopus compressus were kindly furnished by L. N. Allen of Montgomery, Ala.

The writer is indebted to Dr. E. A. Brandt of the Soil Conservation Service, U.S.D.A., and Dr. O. A. Pope of the Division of Cotton and other Fiber Crops and Diseases, U.S.D.A., for assistance in the statistical analyses.

TABLE 1. - The Effect of Different Temperatures on the Germination of seed of Axonopus compressus
Freshly harvested seed sown September 23, 1940. (2 x 100 seeds used)

Sample No.	Pure Seed %	Percentage of germination at specified temperatures (°C) and indicated substrata on the following days after sowing: Room and 35° dark — KNO_3 10 days	KNO_3 14 days	KNO_3 21 days	H_2O 10 days	H_2O 14 days	H_2O 21 days	15° dark and 35° daylight — KNO_3 10 days	KNO_3 14 days	KNO_3 21 days	H_2O 10 days	H_2O 14 days	H_2O 21 days	20° dark and 35° daylight — KNO_3 10 days	KNO_3 14 days	KNO_3 21 days	H_2O 10 days	H_2O 14 days	H_2O 21 days
5181	68.00	83	88	88	73	86	87	10	69	84	15	54	88	64	86	92	25	66	84
5185	85.00	89	96	98	72	92	94	34	86	97	21	60	93	62	90	96	21	58	90
5186	94.00	50	56	56	40	52	54	2	42	54	8	36	50	36	52	56	25	39	49
5187	85.50	90	92	94	85	92	92	48	85	91	30	63	94	82	87	90	48	67	78
5188	82.00	88	92	93	86	93	93	44	88	95	27	75	90	74	89	90	46	68	85
5190	69.00	83	89	89	66	91	92	32	74	87	16	62	88	72	85	90	28	62	83
5191	85.32	75	84	86	66	84	88	18	64	79	14	45	80	58	83	88	32	64	86
5192	73.00	85	90	90	72	87	90	30	80	87	18	63	88	62	82	86	28	58	85
5193	74.13	86	94	94	60	85	95	30	79	88	7	59	94	68	89	90	15	49	76
5194	77.00	79	86	87	66	86	90	16	68	88	13	61	86	50	76	91	22	56	88
5195	91.00	70	83	86	56	82	89	20	65	86	10	52	84	55	76	82	18	46	80
5196	92.08	80	90	92	60	84	92	42	74	88	16	38	90	60	81	89	23	56	80
5197	85.00	86	90	90	78	89	92	41	79	88	25	68	86	80	87	90	28	62	78
5198	85.97	85	93	94	77	92	98	53	84	96	32	66	94	64	85	94	20	55	72
5199	76.00	58	61	64	54	56	58	27	40	48	33	46	62	54	58	62	49	56	57
51100	60.00	86	90	94	85	90	96	54	84	95	42	79	96	81	92	96	52	76	93
51122	70.73	80	86	89	72	90	92	60	86	89	19	66	90	60	86	89	19	66	90
Average:		80	86	87	69	84	88	33	73	85	20	58	85	64	81	86	30	59	79
Mature Seed Sown March 14, 1941																			
5181	68.00	86	88	88	81	85	86	68	81	90	70	80	82	82	85	85	80	81	82
5185	85.00	97	98	98	91	98	99	95	97	98	92	96	96	96	97	97	94	95	95
5186	94.00	52	58	61	52	56	58	42	50	54	38	43	50	46	52	55	42	48	50
5187	85.50	90	91	91	86	89	92	86	90	91	82	89	91	92	93	93	91	93	94
5188	82.00	91	92	92	89	89	90	90	93	94	92	94	94	92	93	93	92	94	94
5190	69.00	90	94	94	35	89	89	70	84	87	73	86	90	90	92	92	88	92	92
5191	85.32	79	82	86	73	80	84	63	77	81	59	76	85	83	88	90	78	82	85
5192	73.	91	91	92	85	89	90	81	87	88	88	92	93	90	92	93	90	90	90
5193	74.13	91	93	93	90	93	94	88	94	94	89	94	96	93	94	94	93	94	94
5194	77.00	83	85	86	86	88	89	83	88	89	80	88	90	87	89	89	84	88	88
5195	91.00	82	86	88	85	91	92	82	89	92	78	88	90	84	87	89	88	92	92
5196	92.08	88	92	92	89	94	94	83	90	92	74	90	91	88	91	92	88	94	95
5197	85.00	90	91	92	88	90	90	86	90	90	86	89	90	93	94	94	88	91	92
5198	85.37	98	98	98	94	98	98	94	96	96	96	97	98	96	96	96	96	96	96
5199	76.00	41	53	54	44	50	54	26	48	60	22	51	62	40	55	57	42	54	57
51100	60.00	96	97	98	92	96	97	83	92	92	84	96	96	84	87	88	90	93	94
51122	70.73	84	87	87	85	90	92	84	88	88	80	86	86	84	86	87	90	90	90
Average:		84	87	88	82	86	88	77	84	87	75	84	87	84	86	87	83	86	87

There was no significant difference in germination when the seeds were germinated at room temperature and 35°C and 15°C and 35°C alternating temperatures, but there was a highly significant difference in the germination between these two alternating temperatures and 20°C and 35°C alternating temperatures. There was no significant difference in germination at the three alternating temperatures on the March sowing but on the September sowing there was a highly significant difference between 20°C and 35°C alternating temperatures and the other two alternating temperatures.

Table 2. - Analyses of Variance of Seed of Carpet Grass Axonopus compressus germinated at three different alternating temperatures

Variables	D/F	Sum of Squares	Mean Square	Found	Required 19:1	Required 99:1
KNO_3						
Samples	16	26,165.628	--	--	--	--
Dates	1	63.706	63.706	4.571*	3.96	6.96
Temperatures						
15°-35° vs 20°-35°	1	38.118	38.118	2.735	3.96	6.96
(2)(R-35°) vs (15°-35°+20°-35°)	1	48.039	48.039	3.448	3.96	6.96
Dates x temperatures						
15°-35° vs 20°-35°	1	18.382	18.382	1.319	3.96	6.96
[(2)(R-35°)] vs (15°-35°+20°-35°)	1	14.912	14.912	1.070	3.96	6.96
Dates x samples	16	205.627	12.852	--	--	--
Temperatures x samples	32	396.852	12.402	--	--	--
Dates x temperatures x samples	32	512.364	16.011	--	--	--
Error (a)	80	1,114.843	13.936	--	--	--
Between duplicates (error (b))	102	987.000	9.676	--	--	--
Total	203	28,450.628	--	--	--	--
H_2O						
Samples	16	27,091.255	--	--	--	--
Dates	1	465.020	465.020	18.947**	3.96	6.96
Temperatures						
R-35° vs 15°-35°	1	56.941	56.941	2.320	3.96	6.96
(R-35°-15°-35°) vs (2)(20°-35°)	1	642.510	642.510	26.179**	3.96	6.96
Dates x temperatures						
R-35° vs 15°-35°	1	28.265	28.265	1.152	3.96	6.96
(R-35°+15°-35°) vs [(2)(20°-35°)]	1	588.480	588.480	23.978**	3.96	6.96
Dates x samples	16	494.313	30.894	1.259	1.77	2.24
Temperatures x samples	32	684.225	21.382	--	--	--
Dates x temperatures x samples	32	784.913	24.528	--	--	--
Error (a)	80	1,963.451	24.543	--	--	--
Between duplicates (error (b))	102	2,364.000	23.176	--	--	--
Total	203	33,199.932	--	--	--	--

*Significant difference.

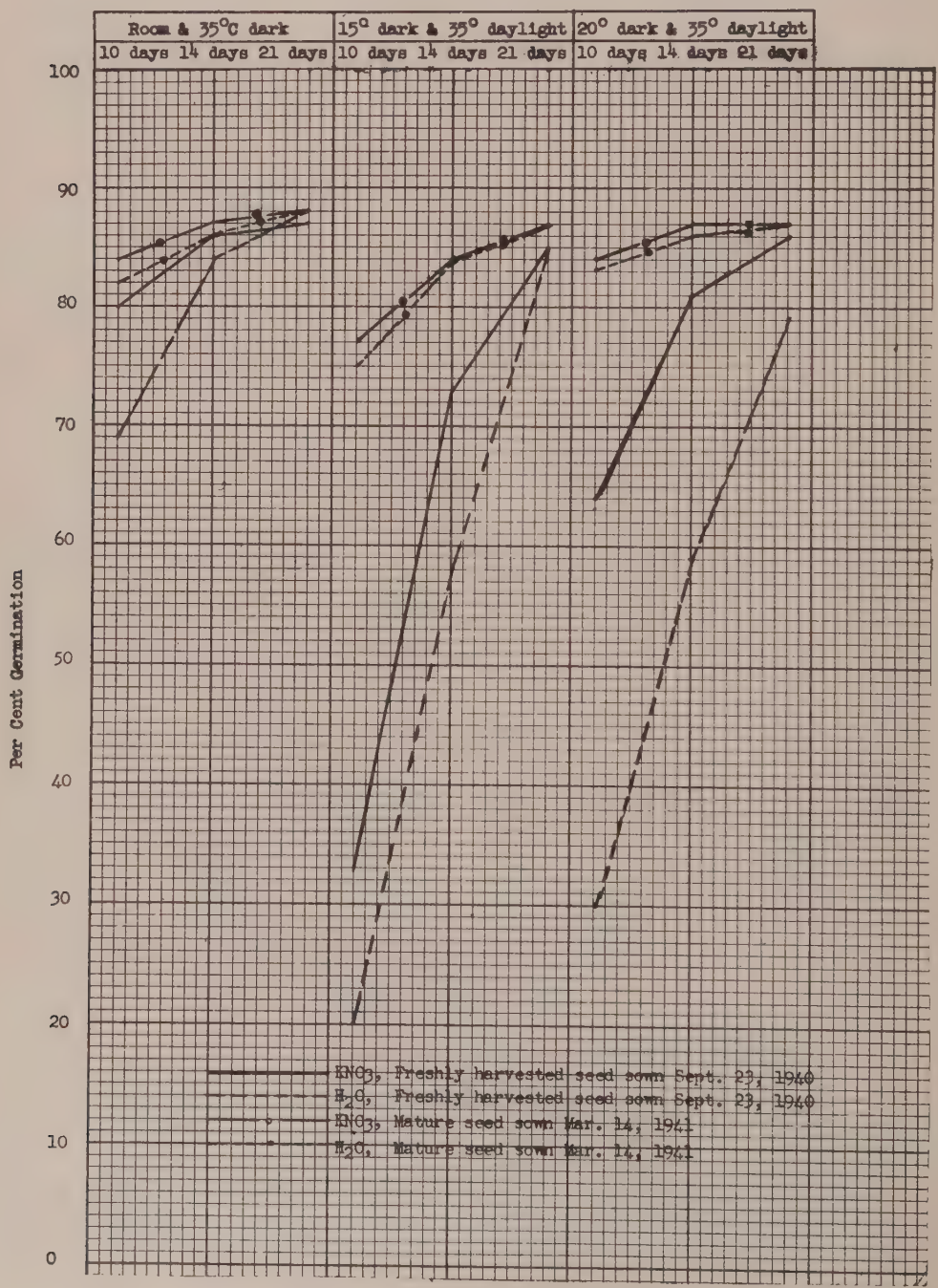
**Highly significant difference.

Germination was slower at 15°C dark and 35°C daylight alternating temperatures on the 10-day and 14-day counts than at the other two alternating temperatures.

As room temperature is so variable in different parts of the country the above results indicate that freshly harvested seed sown on substrata

moistened with water or with dilute potassium nitrate solution and germinated at 15°C dark and 35°C daylight alternating temperatures or sown on substrata moistened with dilute potassium nitrate solution and germinated at 20°C dark and 35°C daylight, alternating temperatures, gave satisfactory germination and approximately the same percentage of germination as when sown several months later.

Graph 1. - The effect of different temperatures (°C) on germination of 17 samples of freshly harvested and mature seed of Axonopus compressus.



SOME SEED CONTROL FIELD PROBLEMS

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When one has become convinced that the control fields or proving grounds are a very necessary part of the seed laboratory equipment or seed control program then comes the task of solving the problems attendant thereto.

One of the first problems to be solved each season is that of what crop or crops to plant during that season. This is easily determined by definite indications well in advance of the planting season and need not be made known to vendors of seed stocks at any time. For instance, early this past season it was evident that there were certain substitutions of other types of rape seed for the genuine Dwarf Essex variety which was scarce. The desirability of collecting adequate samples was plainly indicated. Thus it is easily possible each season to decide what should be planted so as to provide a rotation of crops which will supplement each other through the entire season and provide continuous attention instead of too much at a peak period and still entirely meet the needs of the fundamental plan of field controls.

Disappointments in field arrangement and the possibility of objections from any sensitive vendor whose stocks may be under control will be largely prevented by having a thoroughly satisfactory level plot of land, not so clayey as to distort root crops or so stony as to be objectionable for small vegetables. Have sufficient numbers of plants for an adequate trial, each plant and not each fruit being a unit. The number of replications depends upon the amount of detail to be studied. Only a short row of a few feet may be needed for a simple varietal determination, yet replications may be required for comparative yields. The rows should be far enough apart to avoid any buffer effect. There should be adequate control stocks of an adapted known variety at frequent intervals for use as comparative specimens and as indicators of variations in soil and cultural conditions. Insect pests and plant diseases must be kept under adequate control. There should be substantial stakes bearing the row number, the number of the sample, its complete identity, and its source or origin. Plantings must be adequately and completely labeled with full information if criticism of the visiting public is to be avoided. Shielded information as to source or incomplete row labels seemingly arouse suspicion on the part of vendors concerned and create doubt in the minds of the visiting public. Needless duplication in arranging the plantings can be eliminated by knowing the source of the seed sample so that the rows can be serially and alphabetically arranged and fit the area available and still provide at least one planting of each source.

The difficulties of accurate and sufficient notes and descriptions in all important cases can be largely eliminated by utilizing new photographic methods, particularly color films which will record the exact color of the flowers, fruits, leaves, roots or entire plants which are irregularities. Impressions made of cut roots containing colored juice such as those of beets upon the page of absorbent note paper have proved to be excellent records. Also, outline pencil drawings around pods or fruits have proved to be very useful.

The possibility of accidental mixing or misplanting is entirely eliminated when the original seed container or packet can be taken into the field and the planting made directly into the row and then at that moment the packet is plainly marked with the row number. Incompetent or careless help must be avoided when planting if one would prevent errors which may

reflect harmfully or otherwise upon the vendor. Likewise the possibility of accidental mixing in the open furrow through blowing about of the seed or through seed sticking to the moist fingers must be carefully guarded against since even a slight admixture of plants in a row may present a very deplorable appearance or picture to the visiting public. Certain planting operations can be entrusted only to the more competent staff members.

Differences in field response can be prevented by having the same worker do all of any one operation such as opening furrows, dropping the seed or covering. Any tendency toward selecting plants during thinning or transplanting must be positively avoided by exercising arbitrary unbiased decision if one is to maintain the relative integrity and representativeness of the stock as it was actually sold.

To guard against losing any telltale characteristics, observations should be made and notes taken continuously from the time of emergence of the plants until harvest, noting the rapidity, vigor and uniformity of come-up to check laboratory germination, as well as the comparative seedling characteristics, and then later the plant characters. To lose an important observation such as tassel color in corn or any other temporary characteristic may mean the entire loss of an opportunity to detect a substitution or prove a point.

The problem of securing competent field experts or judgement is usually easily met by using the plant breeders or geneticists of the state agricultural college. Oftimes a group of interested seedsmen will gladly provide thoroughly competent judgement. In fact it is often desirable to urge seed sources to compare and judge their own offerings. In some instances it may be desirable to refer a questionable planting to the originator of the plant introduction. A change in plant characters due to environment may take place and thus will be detected quickest by the originator of the type or strain.

The use of a type name instead of a definite variety name may make the work of proving type or variety more difficult or easier as the case may be. For instance, to decide whether a planting of oats is of Swedish Select type or is the Swedish Select variety presents quite a different problem. The same is true of such offerings as Leaming (variety) corn or Leaming (type) corn. Sometimes the problem is easily solved by a knowledge of the policy of the source of the seed stock so named. One soon comes to know and recognize a considerable number of seed sources by their integrity. In fact, the use of certain field-proved and genetically pure stocks from entirely reliable sources or seed breeders as controls or checks has definitely proved to be a great advantage.

Problems of cost of maintenance and operation of control field or trial grounds can often be largely offset by making good use of the finished crop for any number of purposes, even for class instruction uses or through direct sales. Instances have occurred where the use of the control field plantings for crosswise spraying experiments have more than offset the cost of maintenance. Also, the yielding of breeding or genetical material has in some cases more than compensated for the cost of the project. A number of plans will come to hand to solve the cost item. Even if the cost must be met entirely by one outlay of funds the amount needed is not as large as is generally expected. Frequently the cost per unit or sample is less for the field work than it is for the laboratory work and in many cases is far more effective in bringing about the desired results, namely, proving up the good stocks as well as revealing the poor ones.

Publication problems which arise and which prevent full reports on field performance are sometimes adequately met by sufficient field days when visitors and seedsmen may come and see well-arranged comparative plantings growing side by side. Thus they are like an open book, and "he who runs may read."

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